Documentation

Generated Energy Management System

User Manual and Installation Manual

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Apollo Solar Electric Ltd

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Important Safety Information

Warranty

Apollo Solar Electric has made every effort to ensure the accuracy of the content of this manual. However, it is possible that it may contain technical inaccuracies or typographical or other errors. Apollo Solar Electric will assume no liability for any inaccuracy found in this publication, nor for damages, direct, indirect, incidental, consequential or otherwise, that may result from such an inaccuracy.
The information provided in this manual is subject to change without notice. Apollo Solar Electric reserves the right to alter product designs or specifications without notification.

For further Warranty information please see pages 51-52 of this Manual.

Important Safety Information

All safety warnings give specific details of the potential danger/warning present and indicate how to reduce risk of injury, damage and electric shock resulting from improper use of the device. Carefully observe the following instructions:

- Installation and maintenance must be carried out by a competent person, in compliance with the manufacturer's instructions, the relevant wiring regulations and local safety regulations.

  If in any doubt, consult a qualified electrician.
- The device must be disconnected from the power supply before carrying out any installation work.
- A minimum of 50mm clearance must be provided each side of the device to allow adequate ventilation. The device must be installed in a vertical position.
- Regulations require that the device is earthed.
- Do not remove the device cover while the power supply is connected.
- Do not operate the device with the cover removed.
- Do not attempt to repair or replace any part of the device.
- Do not touch the device with any wet part of the body.
- All Maintenance operations must be carried out by a qualified technician.
- This appliance is not suitable for outdoor use.
- The manufacturer accepts no responsibility for any damage or injury caused by improper use or failure to comply with these instructions.

Introduction

Micro generation systems are at their most efficient when all of the generated energy is used at the point of generation, i.e. within the household where the generator is sited. This results in the minimum possible use of imported energy.

The Apollo GEM system is the most advanced, accurate and versatile micro generation load management device in its class. Apollo GEM can divert surplus generated PV or wind power which would have been exported to the grid to produce hot water, run heaters, power a battery charger or any other appliance. It has two outputs, allowing two heaters or other appliances to be connected to the system.

Apollo GEM can work in two distinct modes; ***variable power*** *mode* and ***threshold power*** *mode*.

In variable power mode the system accurately monitors the power being imported or exported to the property and diverts sufficient power into a hot water or other heater in order to keep the exported power to as near zero as possible whilst at the same time ensuring that no additional power is ever imported to supply the heater. Priority is always given to the energy demands of the household appliances and only surplus energy that would have otherwise been exported is stored in the hot water system.

In threshold power mode Apollo GEM uses a programmable threshold to determine when enough surplus power is available from the micro generation system to power a connected appliance. This mode would be used typically to power non-heating appliances that cannot use a variable power supply. Again, priority is always given to the energy demands of other household appliances.

For hot water heating the Apollo GEM system uses a standard electric water element of up to 3KW to deliver the excess electrical power generated by the PV system to the hot water cylinder.

If the water is normally heated using an electric water element, the same Apollo GEM element will also perform this task using imported electricity at times when insufficient power is available from the PV system but more hot water is required. The Apollo GEM controller incorporates a full function electric water element timer and boost facility for this purpose.

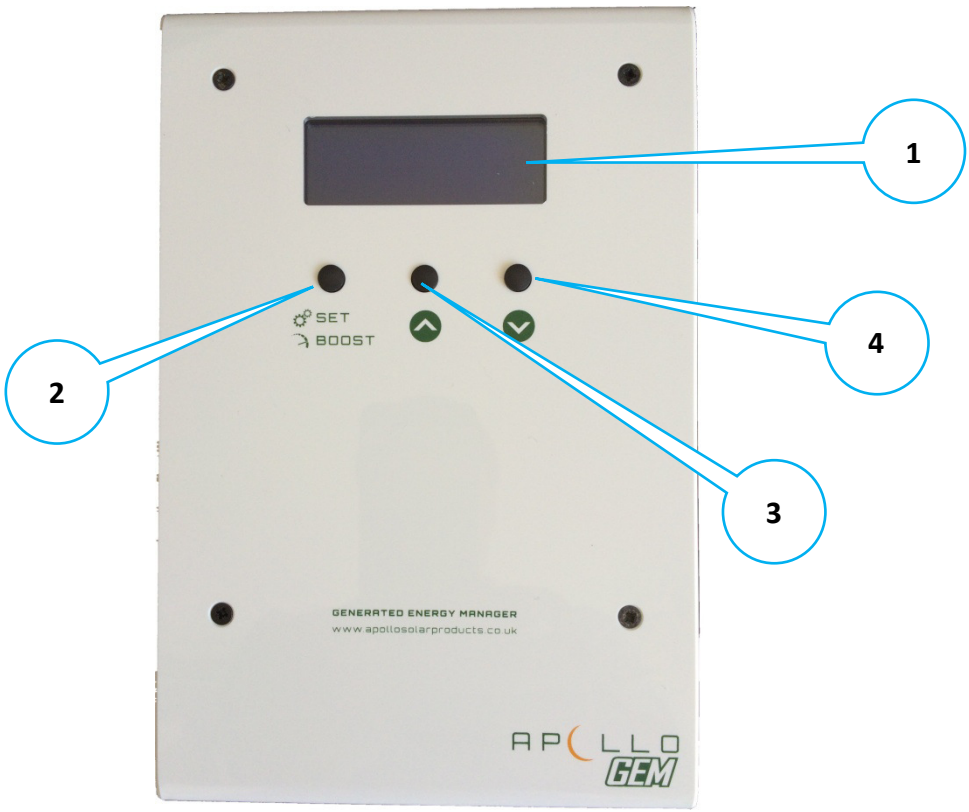
If the water is normally heated using gas or oil the Apollo GEM system will work in conjunction with the normal water heating system. On days when there is insufficient energy available from your PV system to fully heat the water your gas or oil system will ‘top up’ the hot water to the required temperature. Therefore the more energy that is available from the PV system on a given day, the less gas, oil or imported electricity will be needed to provide hot water.

The Apollo GEM Control Unit

The Standard Apollo GEM control unit is usually located near the consumer unit and controls the operation of the whole system.

With the optional wireless sensor transmitter kit the control unit can be located away from the consumer unit, typically near the hot water cylinder or other connected appliance. The wireless configuration may also be required if the water heater or other appliance connected to the controller does not have a dedicated circuit wired back to the consumer unit.

The picture below shows the Apollo GEM control unit and features.

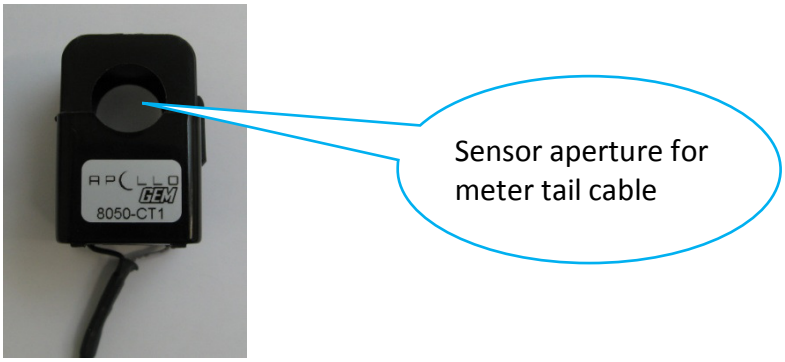


1. Four line status display
2. SET/BOOST Button used to switch on hot water boost or enter set-up mode
3. UP button used to select status display screens or make selections in set-up mode
4. DOWN button used to select status display screens or make selections in set-up mode

The Apollo GEM Power Sensor

The Apollo GEM system senses the import and export power using a clamp-on current sensor unit located near the meter or consumer unit. The current sensor is connected to the Apollo GEM controller.

If the Apollo GEM is using the optional wireless sensor transmitter kit the current sensor is connected to the sensor transmitter unit instead of the Apollo GEM controller unit.



Apollo GEM Current Sensor

Apollo GEM Wireless Sensor Transmitter

Optional Wireless Sensor Transmitter

The sensor transmitter is usually located near or in the consumer unit and transmits the power import/export readings to the Apollo GEM control unit.

Detailed Operation Description

Variable Power Mode Operation

Variable power mode is the default standard operating mode when using the Apollo GEM for water heating using surplus micro generation energy.
The load must be a restive heating load typically rated at 3KW such as a standard water heater.

In this mode the power sensor accurately monitors input and export power to the properly and if export power is detected the controller will start to divert power to the heater. The amount of power sent to the heater is variable from around 50W to the full load power e.g. 3KW.
The actual power sent to the heater will match the excess power being generated keeping the exported power to around zero whilst ensuring that no additional power is imported to run the heater. Priority is always given to the household appliances and generated power is only sent to the heater when it is excess to other requirements.

Threshold Power Mode Operation

Sometimes it is desirable to use the excess generated power to run other household appliances which are not pure heating devices. Any appliance which contains electronics, fans, motors etc. would not be suitable for connection to the Apollo GEM variable power output because such devices always expect to be powered by the full mains voltage. Connection of most appliances to the variable power output would cause them to malfunction.

Threshold mode allows the use of any appliance with the Apollo GEM.
In this mode the system will monitor the level of export power available and wait until sufficient power is available to power the appliance. When sufficient power is available the Apollo GEM output is turned on fully to power the appliance.

It is also possible to run two different appliances in this mode at the same time providing the total appliance load is less than 3KW, or less than 16KW per output if using optional external contactors. The first appliance is powered on when its threshold is reached and if exported power increases further to the second appliance threshold this will be powered also.
As with variable output mode, priority is always given to other household appliances.

Mixed Mode Operation

The Apollo GEM has two outputs and it is possible to run one in variable power mode and the other in threshold mode. This can be used to heat a hot water cylinder, which when up to temperature, the system can then power an appliance in threshold mode if generated power is still available.

Other Apollo GEM Features

Manual Boost Function

In addition to the "optimising" modes where Apollo GEM is using the excess generated power, a manual boost function is provided to allow a connected heater or appliance to be manually turned on irrespective of whether there is excess generated power available or not.

The manual boost function is available on either output and can be set to 1,2,3 or 4 hours.

Operation of this function is described in more detail in the manual boost section of this manual.

Timer Function

The Apollo GEM timer can be programmed to give 3 on/off times per day for Monday to Friday and 3 different on/off times for Saturday & Sunday.

When the timer is on, the water will be heated at full power regardless of whether any surplus PV power is available. This allows water to be heated during off peak electricity times or in the early morning before any PV power is generated.

Each timer on time can switch either output 1 or output 2.

The timer functions are described in more detail in the timer functions section of this manual.

Legionella Control Function

The Apollo GEM has a programmable built-in legionella control cycle that can be used to automatically carry out a heating cycle to prevent legionella colonies from accumulating in the hot water system..

There are two programs available, one for each heater output. If only one output is used or both Apollo GEM heater outputs are in the same physical cylinder only one of the programs need be used.

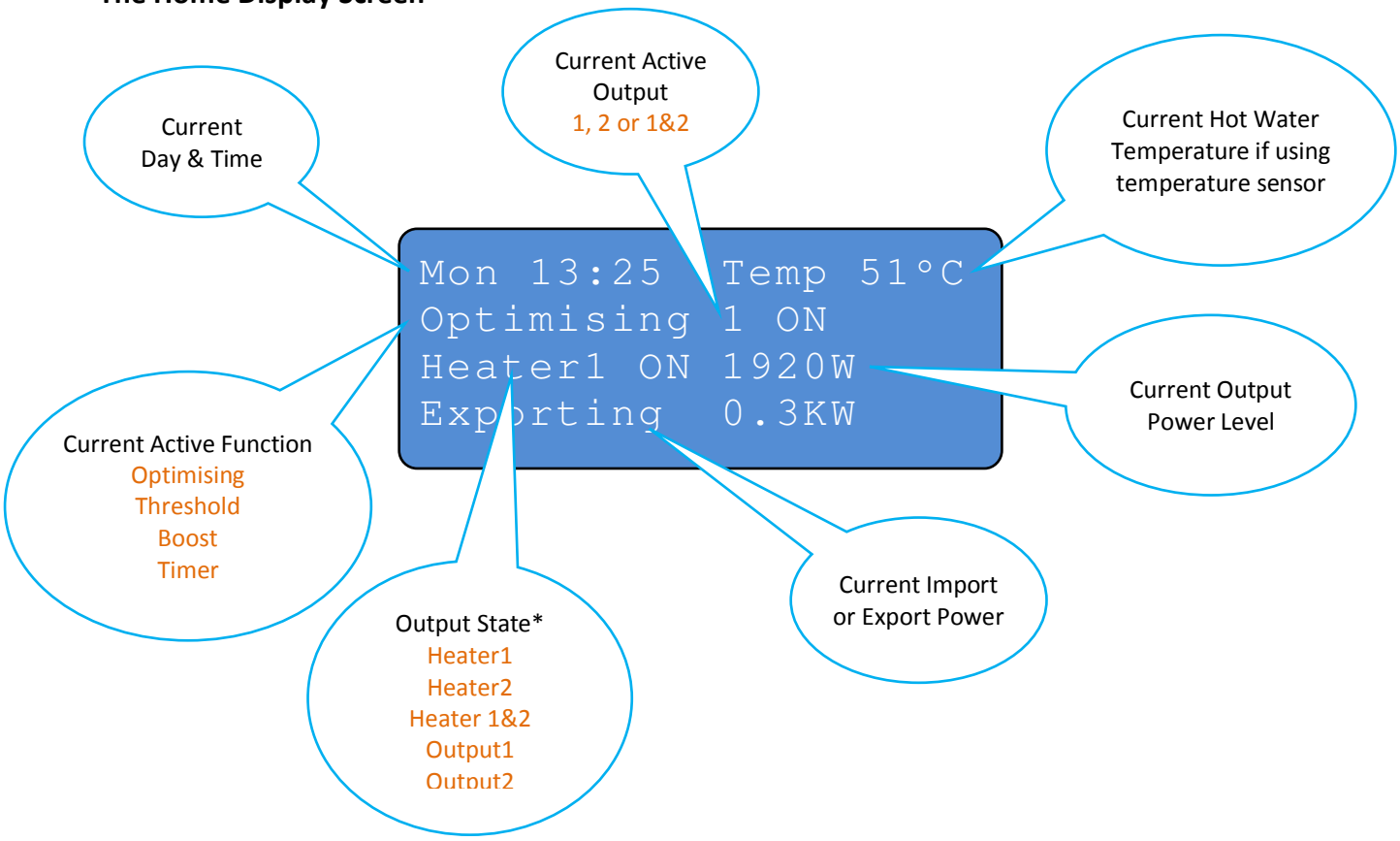
The legionella functions are described in more detail in the legionella section of this manual.

The Apollo GEM Display

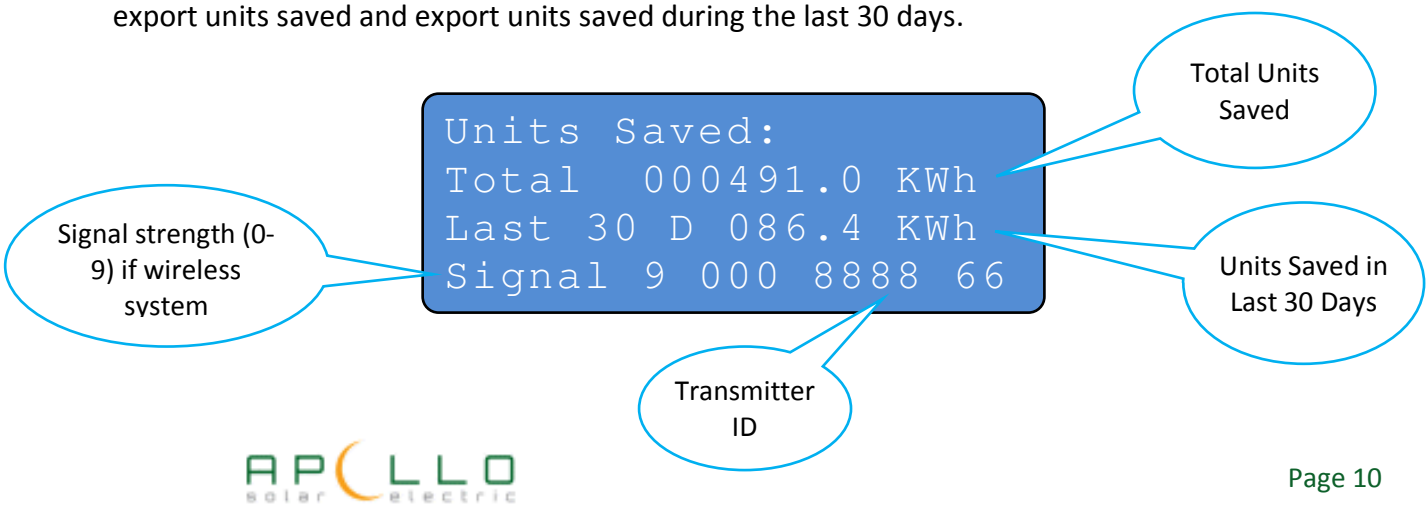
Apollo GEM is provided with a 4 line illuminated LCD display to provide the user with information such as current hot water temperature, export and import power levels etc.

Press any button in order to illuminate the display. The display will stay illuminated for 30 minutes after the last button is pressed before turning off.

The Home Display Screen



Pressing either the ▲ or ▼ from the main screen will change the display to show the total export units saved and export units saved during the last 30 days.


Total Units Saved
Units Saved:
Total 000491.0 KWh
Last 30 D 086.4 KWh
Signal 9 000 8888 66
Signal strength (0-9) if wireless system
Units Saved in Last 30 Days
Transmitter ID

System Function Display

The system function messages are displayed on the 2nd line of the home display. The messages that could be displayed are shown below.

Optimising 1 ON	This is the normal display. Optimising is on and using output 1 in variable power mode and surplus generated energy will automatically be used for water heating.
Threshold 1 ON	This shows that optimising is on using output 1 in threshold mode. The load connected to output 1 will be turned on when the threshold is reached.
Optimising OFF	This indicates that the optimising has been turned off by the user in the set-up menu. All surplus generated energy will be exported.
Optimising DISABLED	Optimising has been disabled by the system due to the error displayed on the bottom line of the display
Boost 1 ON 58 mins	Boost mode on output 1 has been activated by pushing the boost button. The remaining boost time is displayed.
Timer 2 ON	Timer mode is enabled and output 2 is on due to timer on-time programming.

Error Message Display

If no errors are detected by the system the bottom line of the display will show the current power being imported to or exported from the property.
If the system detects an error this is displayed on the bottom line of the display instead of the import/export power.

This is the normal display. No errors are detected and the display shows how much power is being imported to or exported from the property.

Communication with the power sensor transmitter has been lost. (wireless systems only) Check the power sensor is on and is showing a green or orange light. Optimising will be disabled.

Pairing with a new sensor has been requested from the set-up menu or at new installation. See paring later in the manual for more information.

This message can displayed on the third line of the display if the temperature control has been set to "sensor". The unit has detected that no current is flowing to the heater but the set temperature has not yet been reached. Usually due to the heater thermostat being set lower that the temperature set in the menu, but could indicate a faulty thermostat or heater.

Boost Mode

If it is required to boost the hot water temperature at any time using the electric water element, this can be done by simply pressing the boost button.

Boost can also be used to manually turn on an output when operating in threshold mode.

When boost mode is activated the output will be turned on irrespective of whether there is any surplus PV power available.

Pressing the boost button will turn on the boost for output 1.
A second press of the boost button *within 2 seconds* will turn on the boost for output 2.

The system function display will then change to show “Boost 1 ON” or “Boost 2 ON” and the remaining time boost will be active. The first press of the boost button will give a 1 hour boost time. Each subsequent press of the button while boost is on will add 1 hour to the boost time up to a maximum of 4 hours.

A further press of the boost button when boost is already set for 4 hours will turn off boost mode.

Boost mode will automatically turn off when the pre-set temperature is reached or the boost time reaches zero.

Setting the Timer

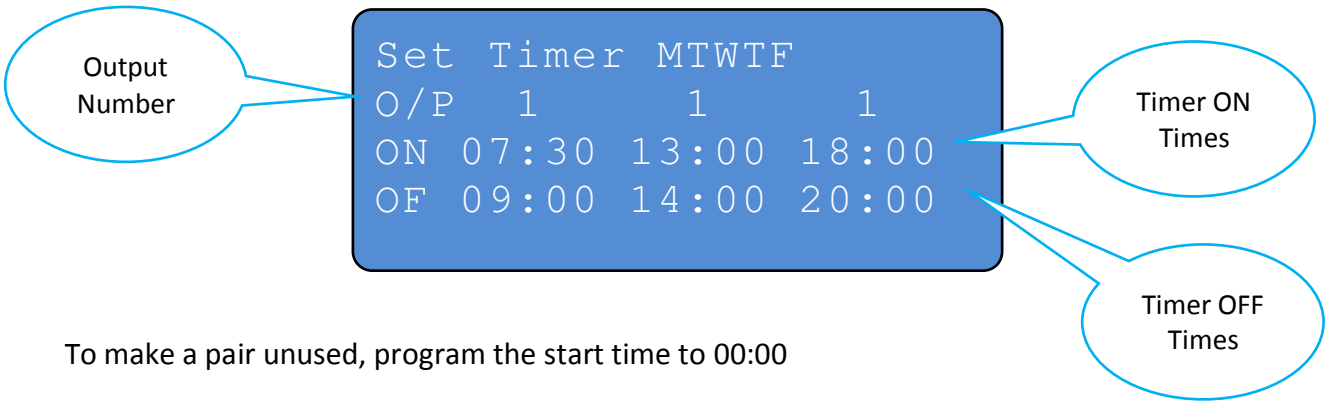
The Apollo GEM timer can be programmed to give 3 on/off times per day for Monday to Friday and 3 different on/off times for Saturday & Sunday.

When the timer is on, the water will be heated at full power regardless of whether any surplus PV power is available. This allows water to be heated during off peak electricity times or in the early morning before any PV power is generated.

Each timer on time can switch either output 1 or output 2.

The timer on and off times are programmed in set-up mode using set-up screen 2 for Monday to Friday times and screen 3 for Saturday and Sunday times.

The timer programming screen is shown below.



To make a pair unused, program the start time to 00:00

NOTE: It is not possible for output 1 and output 2 to be on at the same time.

It is not possible to program times which span midnight, i.e. start one day and end the next. Use 2 time lots if operation across midnight is required.

The 3 ON/OFF times should not overlap. If overlapping times are programmed the timer will turn on at the first start time and the output and remain on until the off time of the second, overlapped time.

Legionella Control Function

What is Legionella?

Legionellosis is the collective name given to the pneumonia-like illness caused by legionella bacteria. Legionnaires' disease is a potentially fatal form of pneumonia and everyone is susceptible to infection. However, some people are at higher risk, including:

- people over 45 years of age
- smokers and heavy drinkers
- people suffering from chronic respiratory or kidney disease
- anyone with an impaired immune system

Where does it come from?

Legionella bacteria are widespread in natural water systems, e.g. rivers and ponds. However, the conditions are rarely right for people to catch the disease from these sources.
However the legionella bacteria can multiply greatly in water storage systems where the temperature remains between 20 and 45^{o}C

How do people get it?

People can catch legionnaires' disease by inhaling small droplets of water, suspended in the air, containing the bacteria such as a shower.

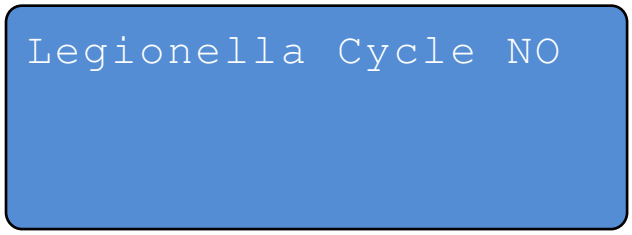
How is it controlled?

Legionella bacteria colonies can be destroyed by raising the temperature of the stored water to 60^{o}C for a minimum of 10 minutes.
For water storage systems that do not regularly operate at 60^{o}C or above it is recommended that a weekly heating cycle to 60^{o}C is carried out. This will ensure that the water system stays free of the bacteria.

The APOLLO Apollo GEM has a programmable built-in legionella control cycle that can be used to automatically carry out this procedure each week.

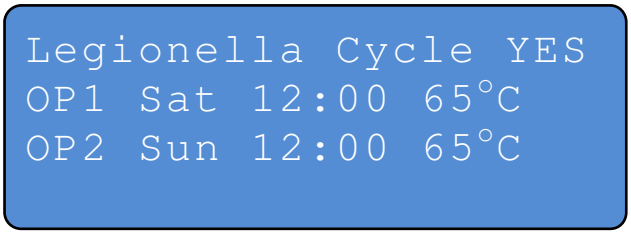
There are two programs available, one for each heater output. If only one output is used or both Apollo GEM heater outputs are in the same physical cylinder only one of the programs need be used.

Legionella control programming is performed using screen 5 in the setup menu:



Setup screen 5
Legionella Control – default is off

To enable the Legionella Control cycle set “Legionella Cycle” to “YES”
The program settings will now be displayed:



Setup screen 5
Legionella Control Settings

Each output can be programmed separately. The program for output 1 is set on the line labelled “OP1” and output 2 on line “OP2”

Press the setup button briefly to advance to each setting to be adjusted and use the ▲ or ▼ buttons to adjust to the required setting.

To disable a programme if control on only one output is needed, set the time to 00:00

The program will commence at the set starting day and time and will continue to heat the water until the programmed temperature is reached. When the programmed temperature is reached the cycle will terminate and normal PV optimising will resume.

If the Apollo GEM tank temperature sensor is not used, the temperature set by the electric hot water thermostat will be used, therefore this should be set to a minimum of 60°C.

The legionella cycle will always heat at full power until the required temperature is reached. If insufficient excess power is available power will be imported to complete the cycle.

To minimise energy costs is it recommended that the cycle is either programmed to start during off peak tariff times (if you have one) or around midday when PV power is likely to be at its highest.

Setting Water Temperatures

Apollo GEM can use one of two methods to control the water temperature:

Using the electric water element thermostat (standard system), or Using the optional Apollo GEM tank temperature sensor.

Each output can be programmed to use either method, or no temperature control.
The method used for temperature control of each output is set in the installer part of the set-up menu.

Using the optional tank temperature sensor has a number of advantages over using the normal electric water element thermostat:

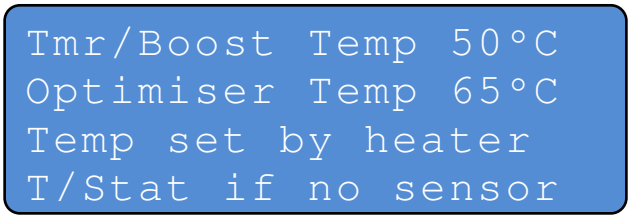
Tank temperature display The home display screen will show a continuous reading of the current hot water temperature.

Better temperature control Water temperature is more accurately controlled than with the electric water thermostat

Programmable temperature The hot water temperature can be programmed from the Apollo GEM unit.

Multiple temperatures Different temperatures can be set depending on whether the water is being heated by on-site generated energy or imported energy. This enables the cost of timed water heating to be minimised whilst maximising available free energy from the generation system

The tank temperatures are set using set-up screen 4:



If there is no temperature sensor installed the temperature is controlled by the heater thermostat and the temperature set in this screen will have no effect.

The Timer/Boost Temp setting sets the required temperature when Apollo GEM is heating the water in timer or boost modes. Since operation in these modes will usually be using imported power a lower temperature can be set to minimise the use of imported power.

The Optimiser Temp setting sets the required temperature when Apollo GEM is heating the water with "free" surplus PV power. The make the most of surplus optimised power a higher temperature can be set for this mode.

Note that to reduce the risk of scalding hot water temperature should not be set higher than 65°C.

If the hot water feed from the tank is fitted with a blending valve, a valve that mixes cold water with the hot water from the cylinder to limit the hot water output to a preset (safe) temperature, then higher tank temperatures than 65°C could be used. The advantage of a higher tank temperature is that this will enable more energy to be stored in the tank.

Note: If the Apollo GEM temperature sensor is being used to control the water temperature the electric hot water element thermostat should be adjusted up to its maximum in order to prevent the electric hot water thermostat interfering with the Apollo GEM sensor temperature control.

Some standard electric water thermostats can only be adjusted up to a maximum of 60 or 65 °C and therefore a higher temperature thermostat may need to be fitted.

Using Apollo GEM with Other Hot Water Heating Systems

Apollo GEM will work well with an existing gas or oil heating system. The more energy Apollo GEM is able to deliver to the hot water system, the less energy will be needed by the normal hot water system. On summer days it is possible that no energy will be used at all by the normal heating system.

In order to give priority to the Apollo GEM system but to ensure that sufficient hot water is always available it is recommended that the thermostat for the normal hot water system is set below that of the Apollo GEM system but high enough to give an acceptable hot water temperature.
e.g. if the Apollo GEM optimiser temperature is set for (say) 65°C, set the normal water heating system thermostat for (say) 50°C or 55°C.

In this way if the water has been fully heated by Apollo GEM the normal water heating will be "Held off" and if there was insufficient surplus energy available to heat the water to the normal water temperature the normal hot water system will come on and "top up" to the required temperature.

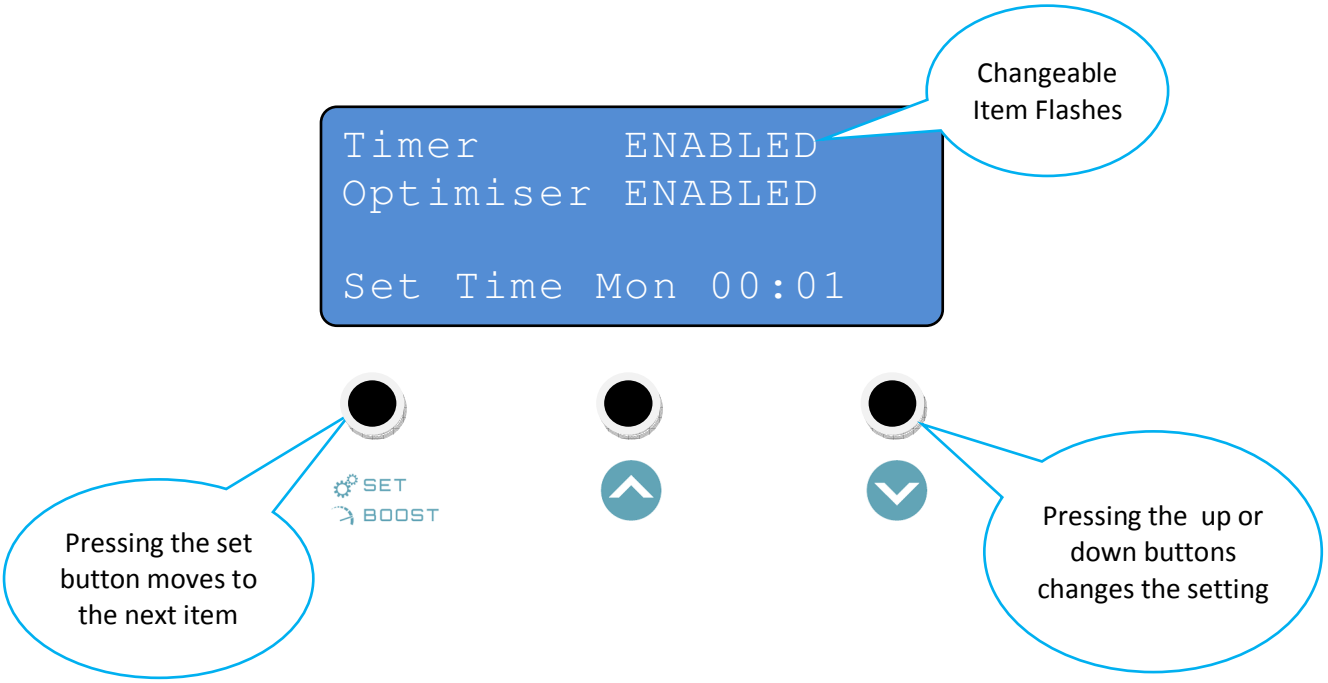
Apollo GEM Set-up Mode

Apollo GEM set-up mode is used to program various operating parameters such as the time/date, enable or disable the optimiser or timer, program the timer on/off times, enter the required optimiser and timer hot water temperatures etc.

Apollo GEM Set-up mode is entered by pressing and holding the set/boost Button SET BOOST for at least 3 seconds.

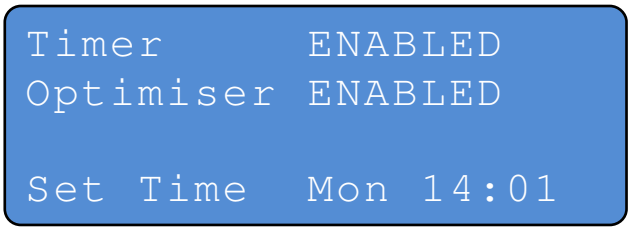
Upon entering set-up mode the first of 8 set-up screens are displayed:

- A setting which can be changed slowly flashes on and off.
- To change the setting press the UP or DOWN arrow keys.
- To move to then next setting briefly press the SET key. SET BOOST
- When the last setting on the screen has been reached pressing the SET key will advance to the next set-up screen
- When the last item on the last set-up screen has been reached the set-up display goes back to the first set-up screen
- Holding the SET key down at any position in a setup screen provides a shortcut jump to the next set-up screen without stepping through each item.
- The changes will be saved and set-up will automatically exit after no keys are pressed for 30 seconds.



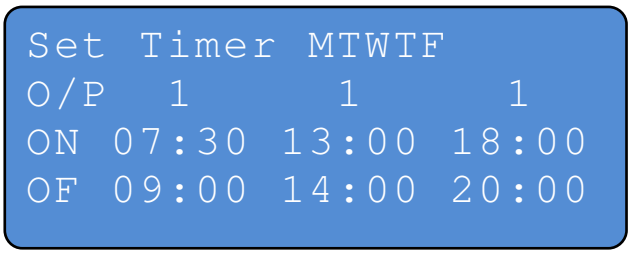
User Set-up Screens

All of the Apollo GEM set-up screens are shown below.



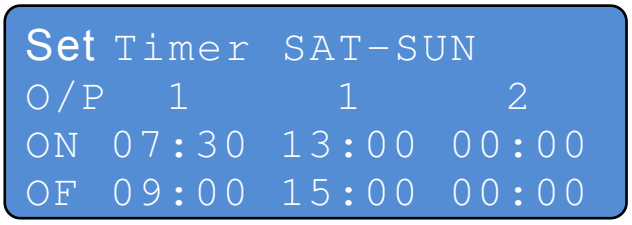
Screen 1. Timer and optimiser enable/disable

The timer and optimiser functions can be independently enabled or disabled.
This screen is also used to set the day and time.



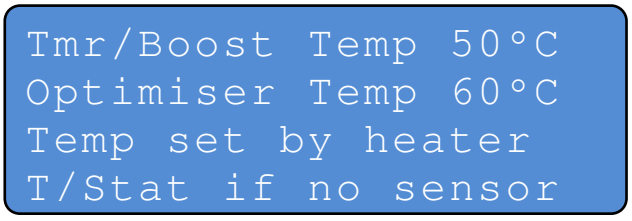
Screen 2. Weekday timer on/off programming

Up to 3 on/off time pairs can be programmed.
On/off pairs do not have to be in time order.
To make a pair unused, program the start time to 00:00



Screen 3. Weekend timer on/off programming

As for weekday programming



Screen 4. Temperature Settings

Tmr/Boost Temp sets the temperature when in timer or boost mode.
Optimiser Temp sets the temperature when using excess generated energy in optimiser mode.

Screen 5. Legionella Control

Program settings for the legionella control cycle on outputs 1 & 2
Set Legionella Cycle to "NO" to disable legionella functions completely (default)

Installer Set-up Screens

The installer menu
Changing Installer Menu? to "YES" will display the 3 additional installer menu screens.

See the installation guide section of this manual for more detailed information about the installer menu functions.

Screen 6. System Set-up Functions

Set-up for unit mode and output priority and radio link sensor pairing if in wireless mode.

Screen 7. Output 1 Set-up Functions

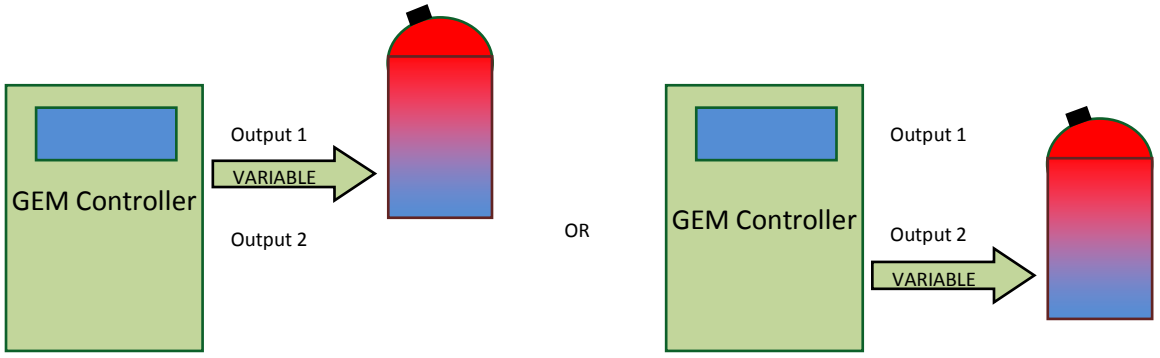
Set-up for output 1
(variable mode shown)

Screen 8. Output 2 Set-up Functions

Set-up for output 2
(Threshold mode shown)

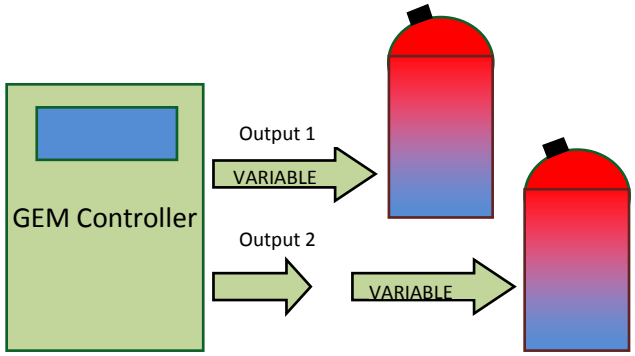
Apollo GEM Variable Output Operating Modes

The diagrams below illustrate the various modes Apollo GEM can operate in using variable power output mode.



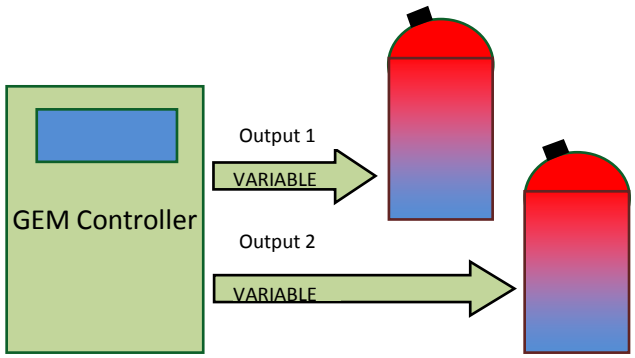
Single Output Mode

Only output 1 or output 2 used



2 Output Priority Modes

Power is diverted to second output when first output set temperature is reached

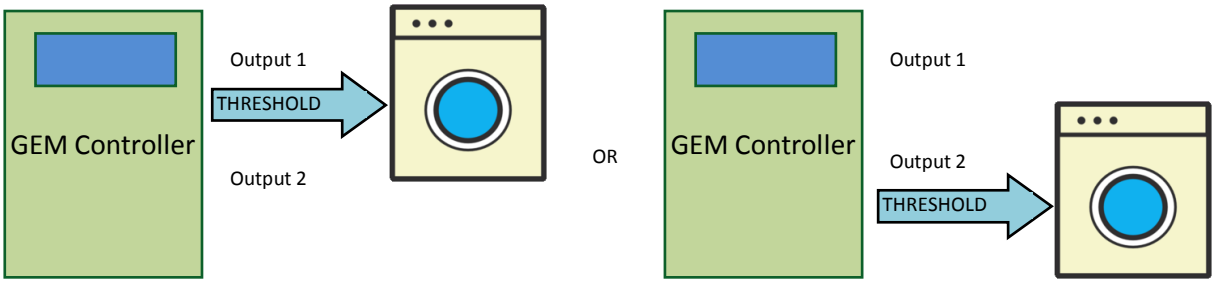


2 Output Power Share Mode

Available power is shared equally between the two outputs

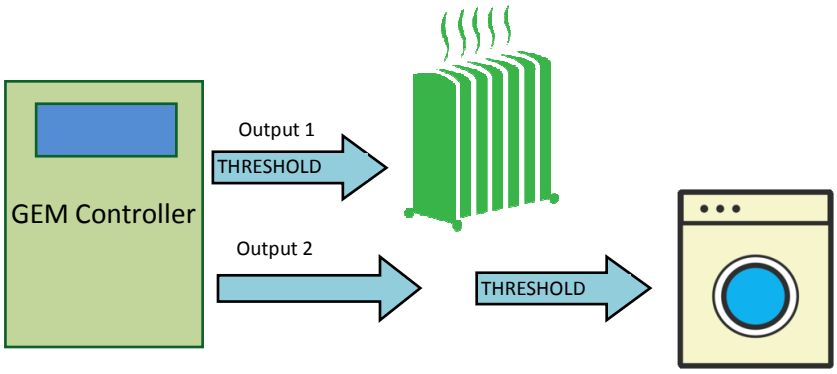
Apollo GEM Threshold Output Operating Modes

The diagrams below illustrate the various modes Apollo GEM can operate in using threshold power control mode.



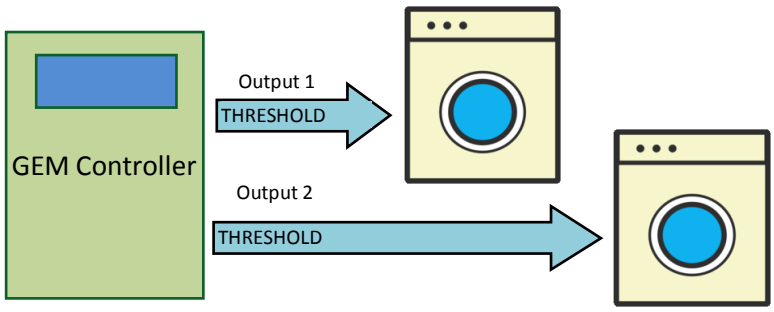
Single Output Mode

Only output 1 or output 2 used



2 Output Priority Modes

Power is diverted to second output when the first output set temperature is reached if the first output is connected to a heating appliance

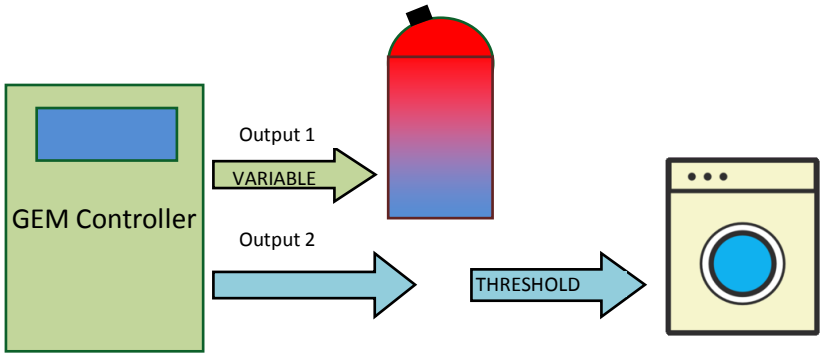


2 Output Threshold Mode

Output 1 is activated when threshold 1 is reached. Output 2 is then activated together with output 1 if sufficient power is available. Total load on both outputs must not be greater than 3KW. Load can be up to 16KW per load if used with external contactors.

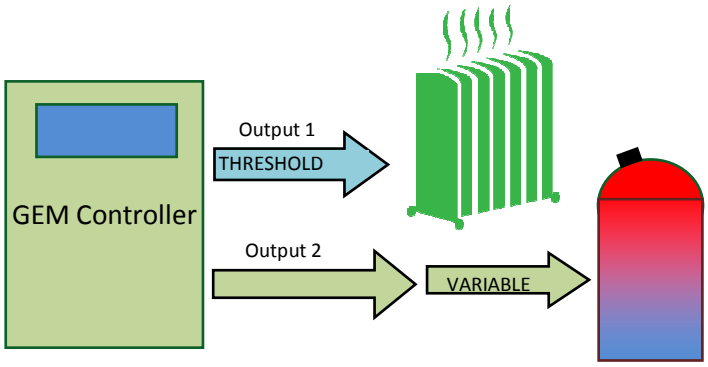
Apollo GEM Mixed Operating Modes

The diagrams below are examples of mixed mode, variable and threshold mode, operation.



Mixed 2 Output
Priority Mode

Initially power is diverted to output 1 in variable mode. When output 1 has reached the set temperature threshold mode operation begins on output 2



Mixed 2 Output
Priority Mode

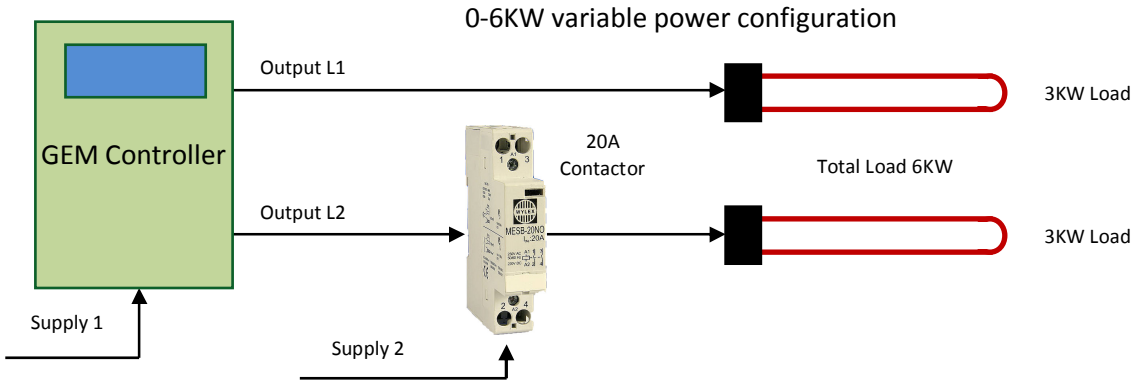
Initially power is diverted to output 1 in threshold mode.
if the first output is connected to a heating appliance power is then diverted to output 2
in variable mode when the set temperature is reached on output 1

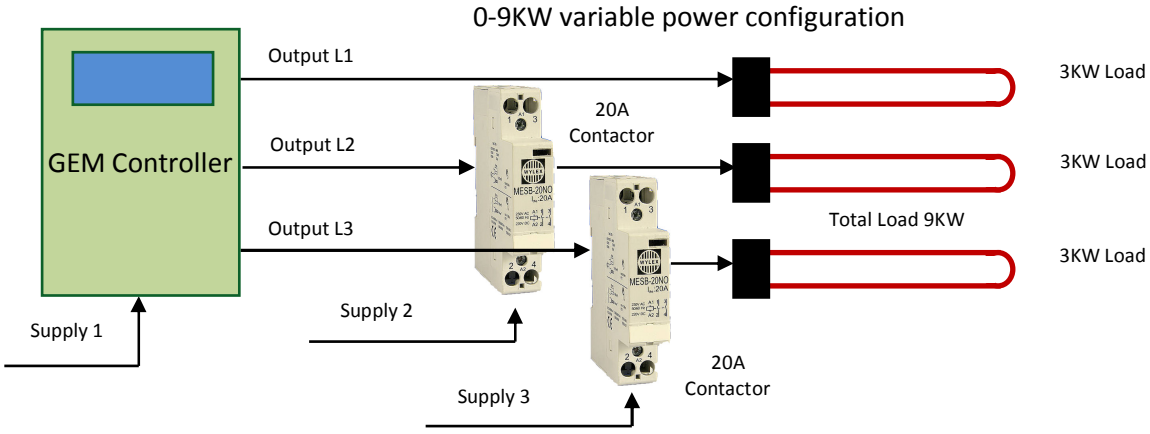
Increasing Apollo GEM Output Power

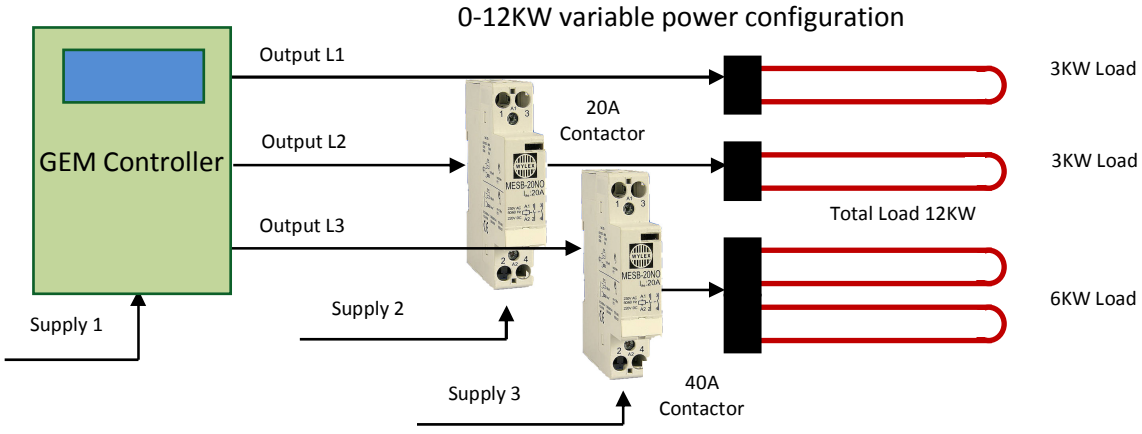
The Apollo GEM output power can be increased from the standard 3KW by the use of external contactors.
For the variable power output mode power can be increased to 6KW, 9KW or 12KW.
For threshold mode operation power can be increased to 16KW.

Variable mode increased power operation

Note that if Apollo GEM is configured to operate in 6, 9 or 12KW mode then only output 1 will be available. Output 2 is used to control the external contactors.





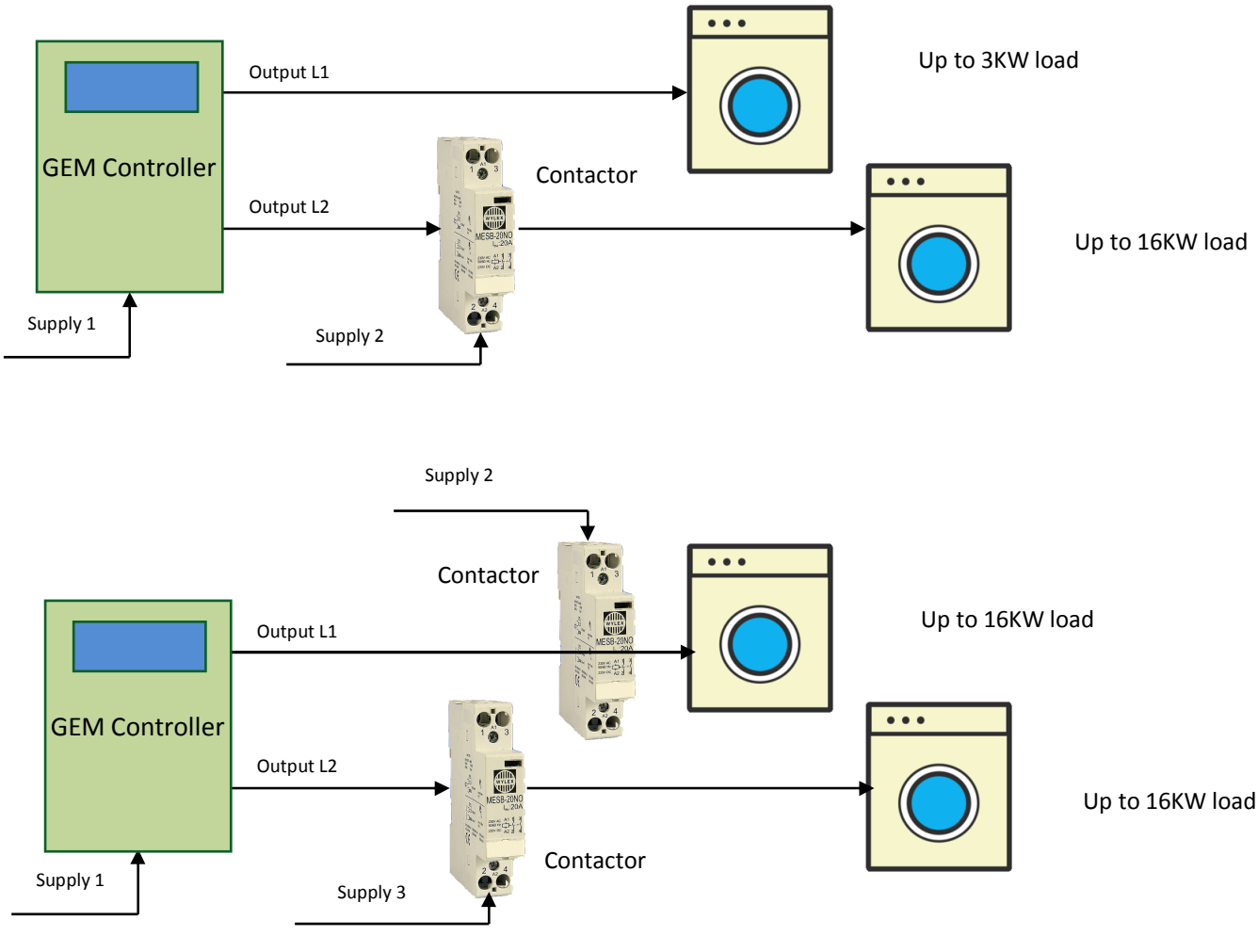


Threshold mode increased power operation

In threshold mode operation the standard Apollo GEM can support a total load of 3KW, i.e. 3KW on each output if operated in priority mode or a total of 3KW for both outputs if operated in 1 & 2 threshold mode.

Threshold mode operation can support loads of up to 16KW per output if the load is connected to the output via a suitably rated contactor.

Example High power threshold mode output configurations



Apollo GEM

Installation Guide

WARNING: ISOLATE MAINS SUPPLY BEFORE COMMENCING INSTALLATION

INSTALLATION AND CONNECTION SHOULD ONLY BE CARRIED OUT BY A SUITABLY QUALIFIED PERSON AND IN ACCORDANCE WITH THE CURRENT EDITION OF THE IEE WIRING REGULATIONS.

A means of disconnection from the supply having at least 3mm contact separation in both poles must be incorporated in the fixed wiring.

If in doubt consult a qualified electrician.

Electric Water (Immersion) Element

The Apollo GEM system uses a standard electric water element up to 3KW and will electronically regulate the power flowing into the heating element to give a controlled power input from 50W to 3000W.

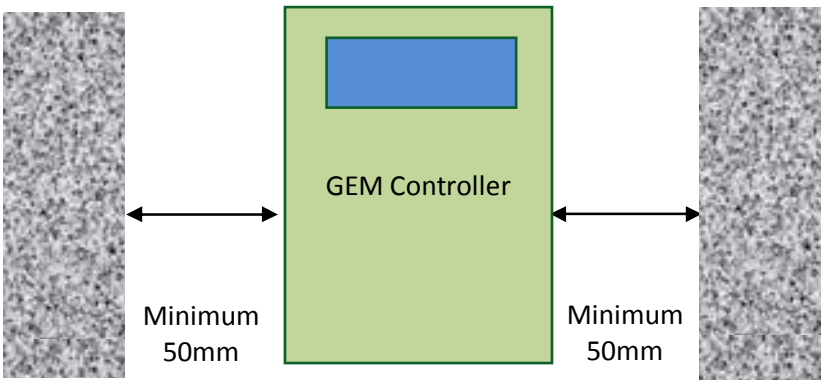
Installing the Apollo GEM Controller

Positioning

The Apollo GEM control unit is generally installed in the vicinity of the main consumer unit.
If used in wireless mode with the optional wireless power sensor the control unit can be positioned in the vicinity of the hot water cylinder.

The control unit has a display and operator controls and so should be mounted in an easily accessible position.

The Apollo GEM controller requires adequate ventilation and must be mounted vertically and such that a minimum of 50mm clearance is provided on both sides of the unit.



Cover removal

Remove the four screws on the front of the unit and the front cover will then slide off.

Cable entry

“Knockouts” are provided for both rear and bottom cable entry.
Use a Stanley knife or similar to cut out the cable access apertures relevant to your installation.

Take care when removing the cut-outs as the edges can be very sharp. Run a file round the edge of the aperture to clean up any sharp edges.

Mounting

Mount the unit onto a wall or other secure surface using the mounting holes in the back of the unit.

Apollo GEM Control Unit Supply

The Apollo GEM controller is connected in series with the electric water element, between the electric water element breaker or isolator and the electric water element.

If a dedicated circuit exists between the water heater and the consumer unit and also the incoming supply from the electricity company upstream of all supply connections, including the PV system, is close to the consumer unit then everything can be direct wired and the standard Apollo GEM system can be used.

If the water heater is supplied from a non-dedicated circuit, e.g. a ring main, or the water heater circuit has other appliances attached such as a shower pump, the wireless connection kit will be required.
The optional wireless connection kit may also be required if it is desired to install the control unit near the hot water cylinder or other location for display visibility, or the main electricity company supply connection is remote from the consumer unit.

Important

(1) If the Apollo GEM controller is located remotely from the water heater e.g. next to the consumer unit a double pole isolator must be incorporated between the Apollo GEM output (L1 or L2) and the water heater and **positioned in the vicinity of the water heater**.

If the Apollo GEM controller is located in the vicinity of the water heater a double pole isolator must be incorporated in the supply to the Apollo GEM and **co-located with the Apollo GEM controller**.

(2) There must be no other appliances or circuits or timing devices connected to the electric water element output of the Apollo GEM when used in variable power output mode.

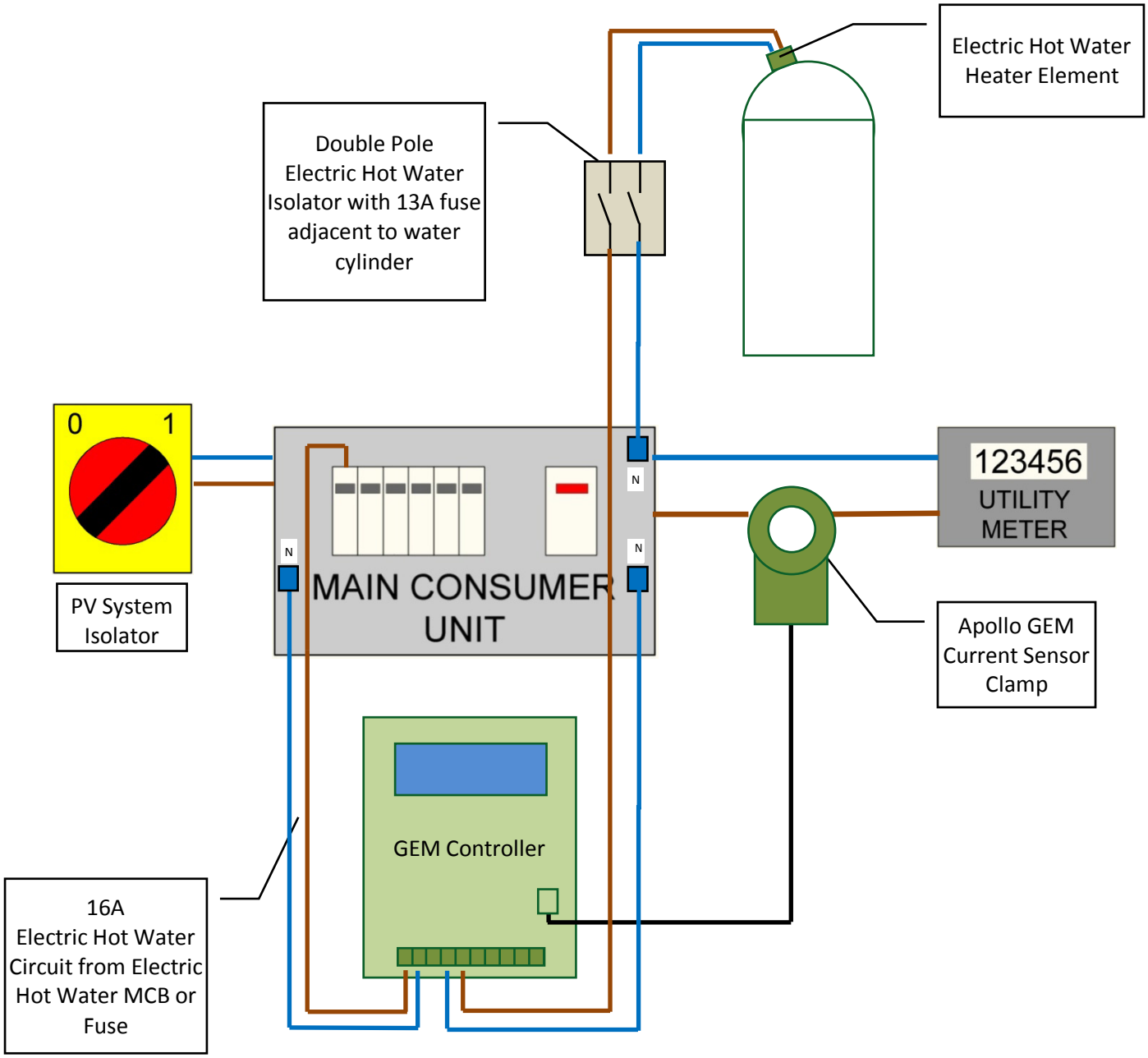
Prior to installing a Apollo GEM system the existing electric water element may have never been used, or used rarely. It is strongly advised to inspect and check the existing electric water installation and ensure that:

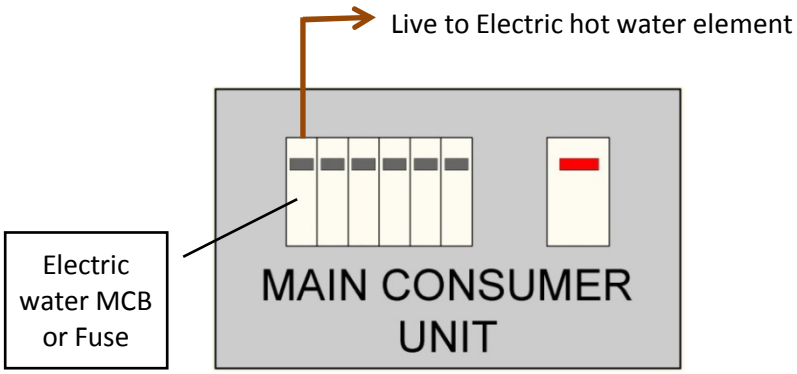
- The cable is adequately sized
- The cable is in good condition
- The terminations in the electric water element and isolator are in good condition and tight

Apollo GEM Direct Wired System Schematic

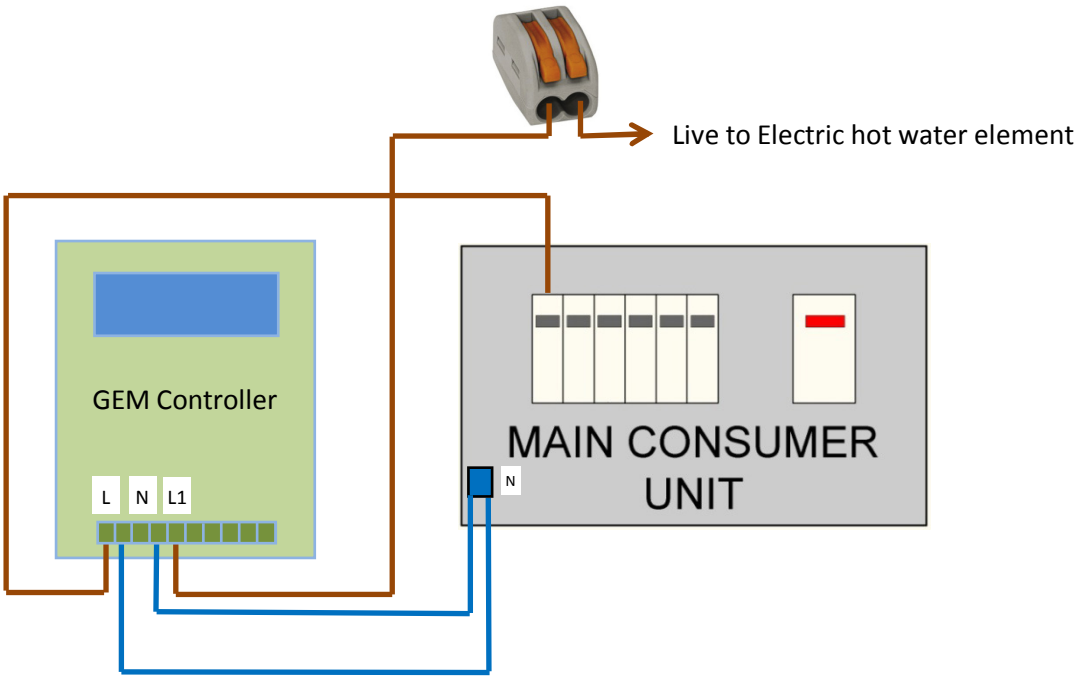
The drawing below shows the wiring connections for the Apollo GEM system when directly wired.

(earth connections not shown for clarity)





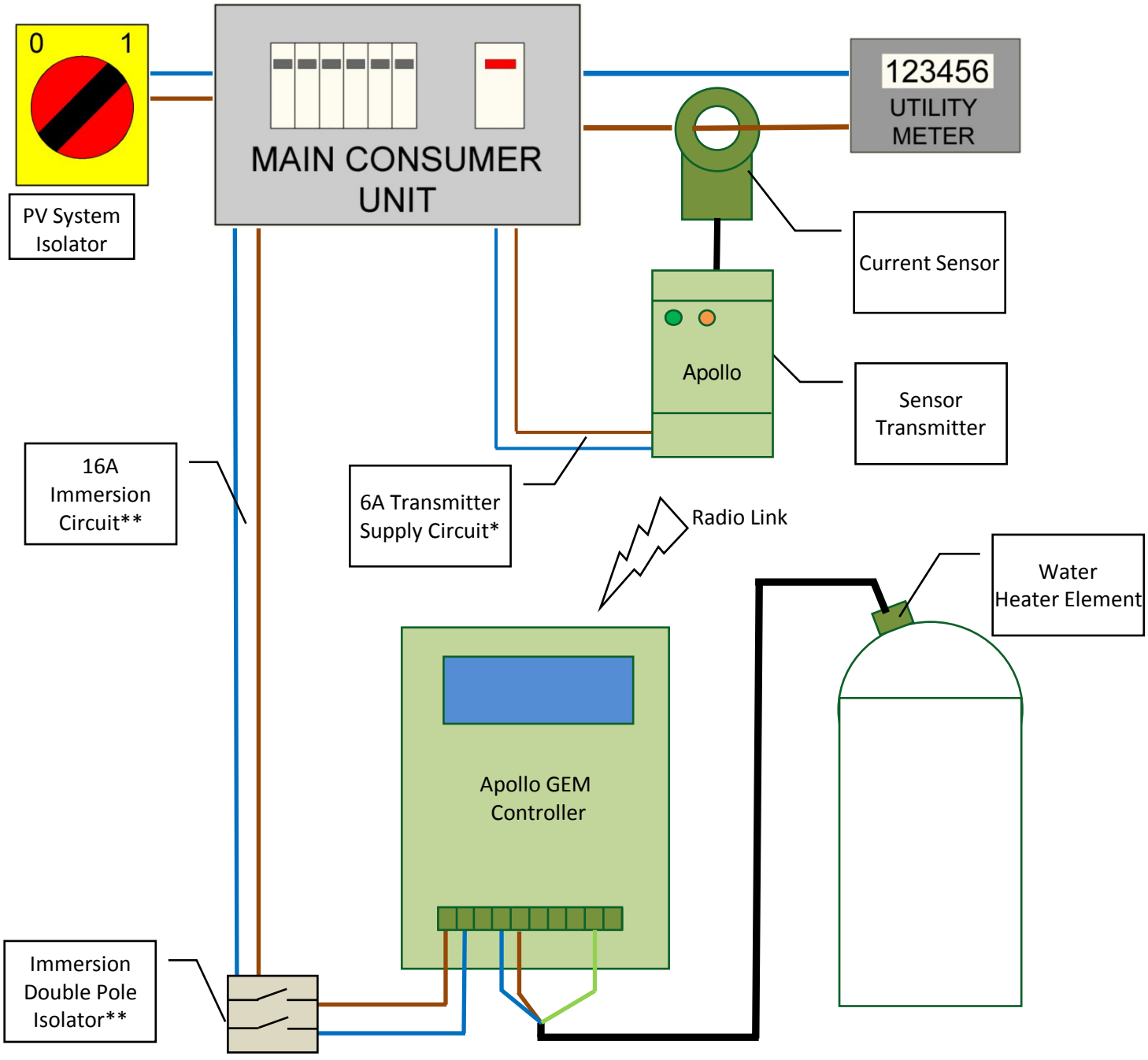
Direct wired electric hot water circuit before Apollo GEM installation
(Neutral and earth connections not shown for clarity)



Direct wired electric hot water circuit after Apollo GEM installation
(Earth connections not shown for clarity)

Apollo GEM Wireless System Schematic

The drawing below shows the wiring connections in the complete Apollo GEM Wireless system.

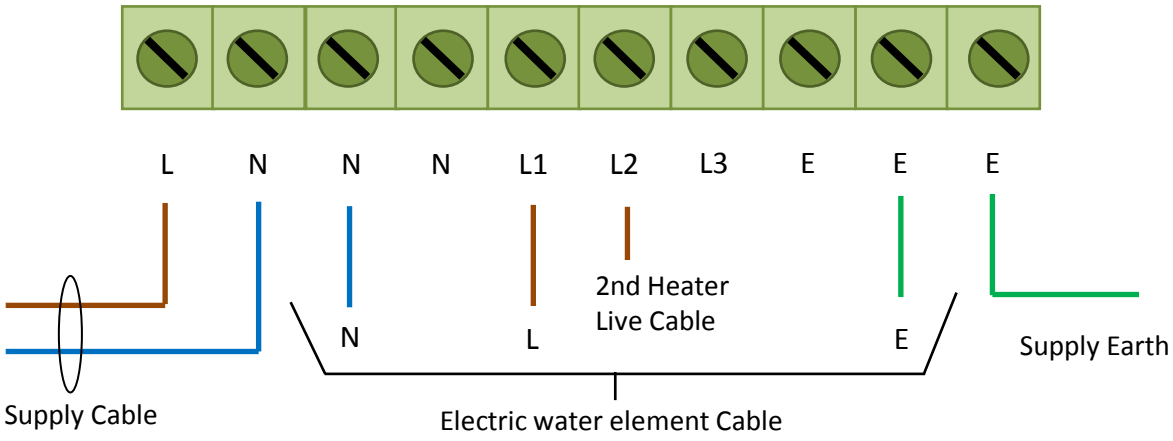


* **Transmitter can also be plugged into standard 13A socket**

** **A double pole & 13A fused isolator fed from a ring main circuit is also acceptable. A dedicated immersion circuit from the consumer unit is not mandatory.**

Electrical Connections

All electrical connections are made to the unit via a screw terminal block located under the front cover as shown:



TERMINAL	CONNECTION
L	Supply live from isolator switch
N	Supply neutral and Heater neutral
L1	Electric Water Element Live (Heater 1)
L2	Electric Water Element Live (Heater 2)
L3	Not used in standard installation
E	Supply earth and electric water element earth

Current sensor clamp connection

The current sensor is supplied with a 2-pin connector and is plugged into the two pin socket marked “CT CLAMP” on the main Apollo GEM circuit board.

For wireless systems the CT clamp input is not used.

Temperature Sensor Connection

If used, the temperature sensor is plugged into a 4-pin RJ11 connector situated at the front of the main Apollo GEM circuit board marked “TEMP SENS”

Connecting to the terminals

Heating appliances draw high currents. It is important that the cables are properly connected to ensure safe operation of the equipment.

Follow the steps below to ensure connections are properly made to the Apollo GEM controller.

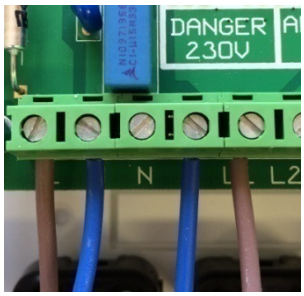
- Prepare the cable end as shown:

Twist tightly together
Do NOT solder

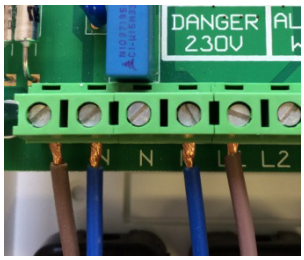
Strip 8mm

- Insert the wire fully into the terminal
- Use the correct size screwdriver and ensure terminal screws are tight but not over tight.
- Check that there are no “escaped” wire strands at the terminal entry.

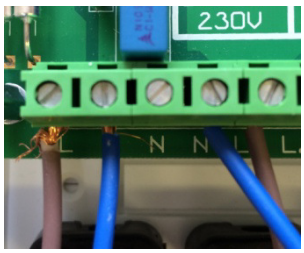
Good Termination



Wires not fully inserted
or stripped too long



“Escaped” wire strands



Installing the Apollo GEM Current Sensor

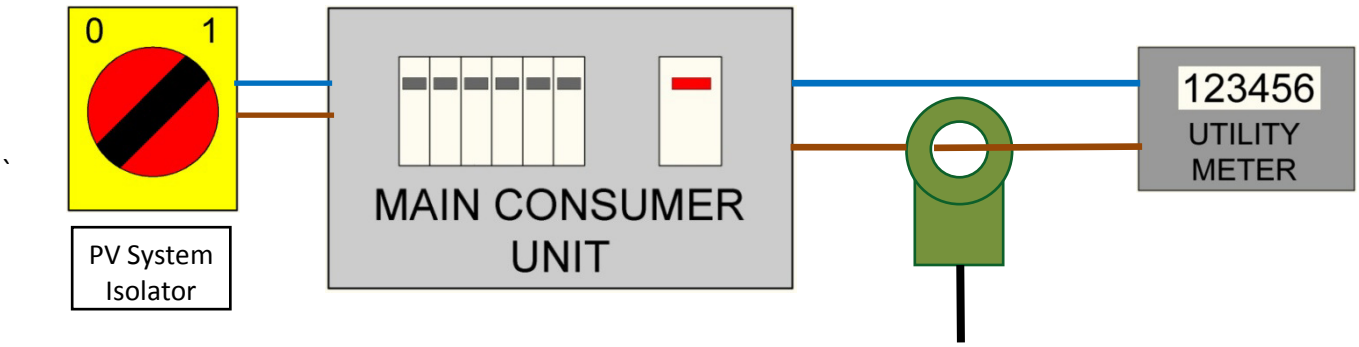
The Apollo GEM current sensor is an opening clamp type sensor that is clamped around the meter tail cable between the main utility meter and the consumer unit.
The current sensor together with the controller measure the power being imported to or exported from the building.

The sensor can be clamped to the meter tail at any convenient location. In many cases the sensor can be inside the consumer unit itself. The sensor however must be located upstream of the PV system connection. If the PV system is connected to the main consumer unit then the current sensor may be clamped round the incoming supply to the consumer unit.

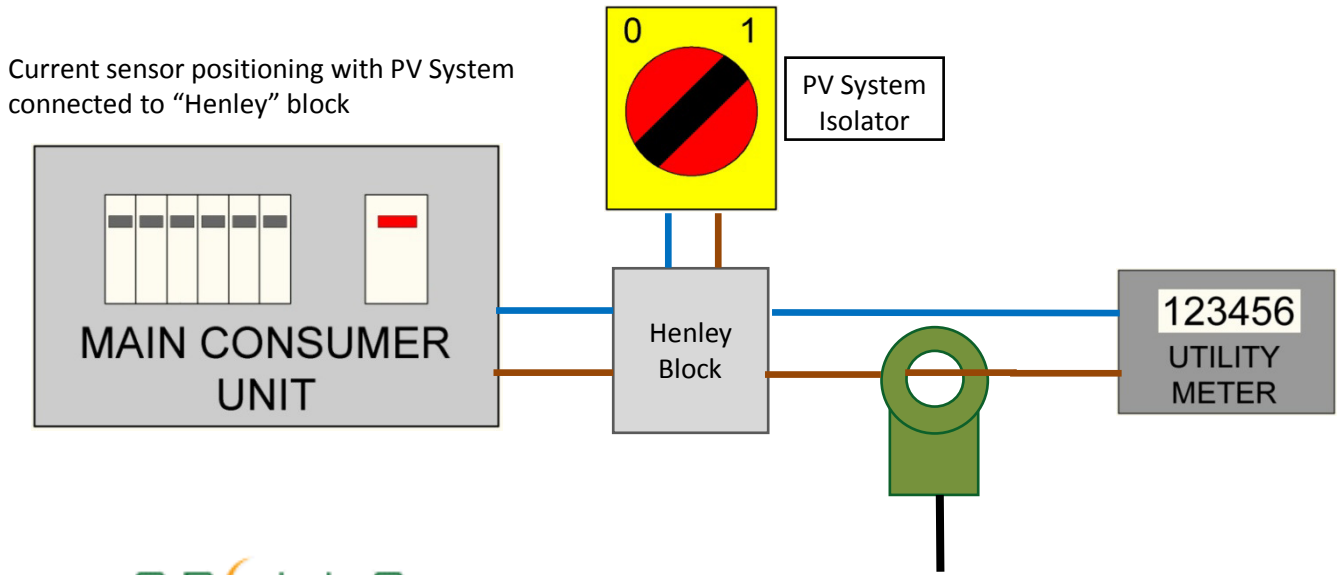
If the PV system is connected via a “Henley Block” in parallel with the consumer unit then the sensor must be clamped round the incoming supply between the meter and the Henley Block.

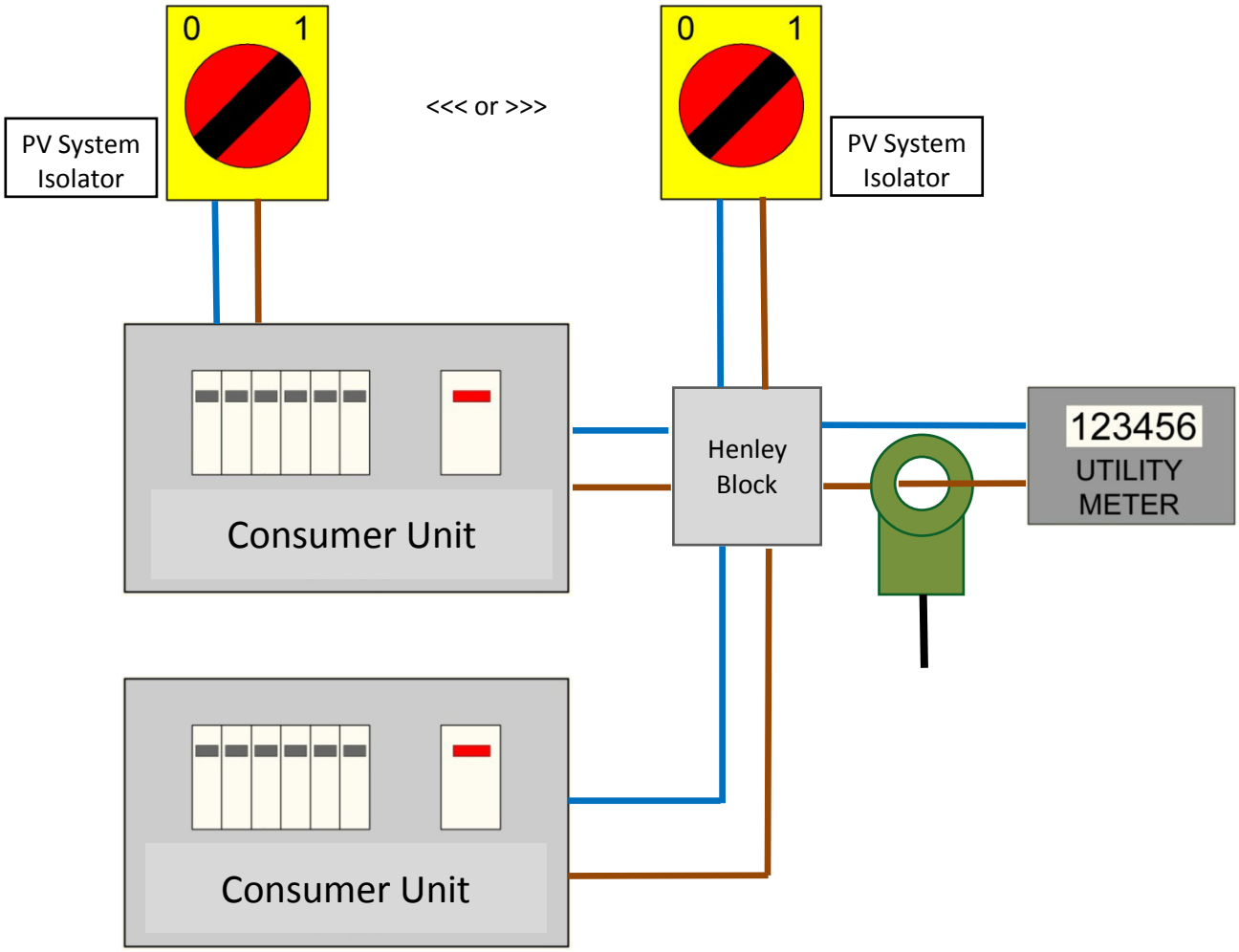
ENSURE THAT THE CLAMP IS FIRMLY “CLICKED” SHUT AROUND THE CABLE

Current sensor positioning with PV System connected to main consumer unit



Current sensor positioning with PV System connected to “Henley” block





Current Sensor Positioning with Multiple Consumer Units.
Position sensor on utility meter side of “Henley” block

The current sensor clamp when installed on the live conductor is positioned with the label “This side facing main meter” facing *towards* the utility meter.

If it is more convenient, the sensor can be installed on the neutral supply cable instead of the live. In this case the label “This side facing main meter” should face *away* from the utility meter.

Sensor Transmitter Installation (Wireless Systems)

The Apollo GEM transmitter is designed to attach to a standard DIN rail and so can be mounted inside a (plastic) consumer unit if there is room. The unit is 2 modules wide.

Alternatively the transmitter can be wall mounted using the supplied bracket, or installed in a mini DIN rail enclosure.

Power can be provided to the sensor transmitter by either plugging into a standard 13A power outlet or wiring directly to a 6A MCB in the consumer unit.

Plug in the current sensor clamp cable to the 2 pin connector on the top of the sensor transmitter.

If required, the standard 3M current sensor clamp cable can be extended up to 50M.

Sensor Transmitter Initial Checks

After installation apply power to the sensor transmitter. On power up the orange LED should light, followed by the Green LED and then both LEDS should go out . After start-up either the green or orange LED should flash. If power is currently being imported the green LED will flash. If power is currently being exported the orange LED will flash. The speed of flash will depend on how much power is being imported or exported. The faster the flashing, the higher the power.

Verify that the sensor is correctly installed using the following procedure:

1. Power on the sensor transmitter
2. Turn off the main solar PV isolator (this ensures no power will be exported)
3. Check that the green LED is flashing (power being imported)
   If the green LED is flashing all is well and the solar PV isolator can be turned back on.
   If the orange LED is flashing the sensor is installed facing the wrong way round.

If the sensor has been installed the wrong way round either re-clamp the sensor facing the other way or reverse the two wires in the green plug at the top of the transmitter module.

Setting up the System

Apollo GEM is a very flexible system with may configuration options to enable use in a wide variety of situations**. If the system will be used for the standard application of diverting excess PV power to a hot water cylinder using a single water heating element the system can be used straight out of the box with no configuration.**

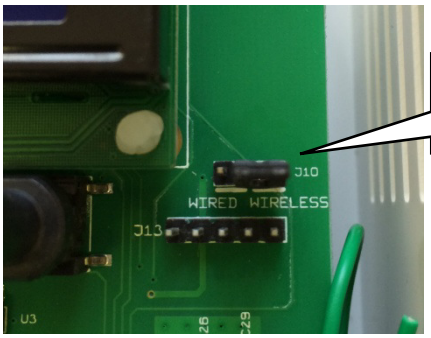
Factory Configuration

- Wired (non-wireless) mode
- Single output on output L1
- Variable power mode for standard 3KW heater
- Temperature control by heater thermostat
- Timer disabled

Setting wireless mode operation

The factory setting is for non-wireless operation.

If wireless operation is required, and the optional wireless sensor transmitter has been purchased, this is set by moving the wired/wireless jumper, located on the main circuit board to the right of the display, from the "WIRED" to the "WIRELESS" position.
This must be done with the controller powered off.
When power is applied to the controller the initial start up display will confirm which mode the system is operating in.

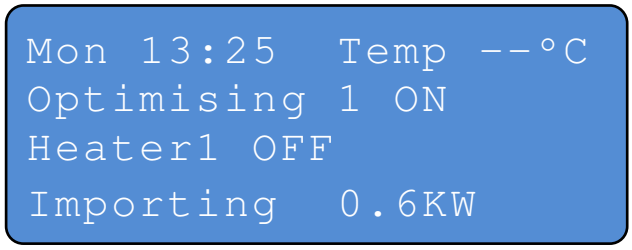


Wired / Wireless selection jumper

Initial Checks (Non-Wireless Installation)

Once all wiring has been completed and checked the following commissioning checks should be performed.

1. Apply power to the control unit. The display should illuminate and a start-up message displayed.
   The “home” screen should then be displayed:



2. Turn off the PV system at the main PV isolator.
   This is to ensure that no power can be exported from the property for the next check:
3. Verify that the bottom line of the Apollo GEM display shows “**Importing X.XKW**”

   If the display shows “**Exporting X.XKW**” then the sensor clamp is positioned on the cable facing the wrong way. Unclamp the sensor and turn it around to face the other direction.
4. If the bottom line of the Apollo GEM display shows “**Importing X.XKW**” the PV system can be turned back on.

   Briefly press the "Boost" button to start boost mode.
   This will check that:
   a) The heater is working and b) The power measuring system is working correctly.

   Check That the display shows "Boost 1 ON 60 mins" and that the measured **import** power has **increased** by approximately the heater power e.g. 3KW.
   (If exporting check the **export** power **decreased** by the heater power)

If Boost mode remains on and the power reading is as expected then everything is working.
Press the boost button four more times to turn off boost mode.

The system is now ready for operation.

If Boost Mode Will Not Stay On

If Boost mode starts but then ends and returns to optimising a few second later, this is because the controller has detected that the heater is not drawing any power. Common reasons for this can be:

- The water is already hot and the thermostat is off
- The thermostat is set at too low a temperature
- The thermostat is not working (failed open circuit)
- The heating element has failed
- The heater is not correctly wired to the controller output

Initial Checks (Wireless Installation)

Once all wiring has been completed and checked the following commissioning checks should be performed.

1. Perform the "Sensor transmitter initial checks" as described above.
2. Select wireless operation using the jumper link as described above.
3. Power on the sensor transmitter or if already on turn off and on again.
4. Apply power to the control unit.
   The display should illuminate and a start-up message displayed.

5. The “home” screen should then be displayed:

Communication with sensor transmitter

At this point , if this is the first time that the controller has been powered up it will be searching for, and attempting to pair with a sensor transmitter unit within range.

Each sensor transmitter unit has a unique ID and the controller will only accept data from one particular transmitter. This is to ensure that only the correct power readings are received where two or more Apollo GEM systems are installed in overlapping coverage, e.g. next door properties.

When displaying the [Pairing New Sensor] message Apollo GEM will search for a sensor signal which is transmitting the “find me” message and ignore signals from any other nearby sensors.

The sensor transmitter will transmit the “find me” signal with details of its unique ID for the first 5 minutes after being switched on.

Once the controller is in the [Pairing New Sensor] mode and if the transmitter has been powered up for more than a few minutes, it will be necessary to turn off the sensor transmitter and back on again. The sensor transmitter unit will then start transmitting the “Find me” signal and the control unit should pair to the transmitter and record the sensor ID.

From this point the controller will only ever receive data from the sensor transmitter which matches the saved ID.

Once successfully paired and receiving data the bottom line of the display will display the import or export power level and optimisation will be on.

Control unit – Sensor transmitter pairing

If the error message [No Sensor Signal] is displayed at the bottom of the home screen, this means that control unit-sensor transmitter pairing has already taken place but no sensor transmitter signal is being received. Reasons for this could be:

- Sensor transmitter is not powered up
- Sensor transmitter or controller has been changed from the ones originally paired.

A new sensor transmitter can be paired with the Apollo GEM controller by going to set-up screen 6 (installer menu) and changing the wireless parameter from “PAIRED” to “START PAIR”
After 30 seconds set-up mode will exit and the pairing process will begin.

Remember to power off and on the sensor transmitter to activate the “Find me” signal.

Set-up Screen 6
(Installer Menu Page 1)
change wireless parameter to "START PAIR" to pair new controller/transmitter

When the system is paired continue:

6. Briefly press the "Boost" button to start boost mode.
   This will check that:
   b) The heater is working and
   c) The power measuring system is working correctly.

   Check That the display shows "Boost 1 ON 60 mins" and that the measured **import** power has **increased** by approximately the heater power e.g. 3KW.
   (If exporting check the **export** power **decreased** by the heater power)

If Boost mode remains on and the power reading is as expected then everything is working.
Press the boost button four more times to turn off boost mode.

The system is now ready for operation.

If boost mode will not stay on but reverts back to optimising after a few seconds, see the section above - "If Boost mode will not stay on".

Apollo GEM Configuration Options

The system configuration options are found in the installer menus at the end of the set up menu screens. There are three installer menu pages.

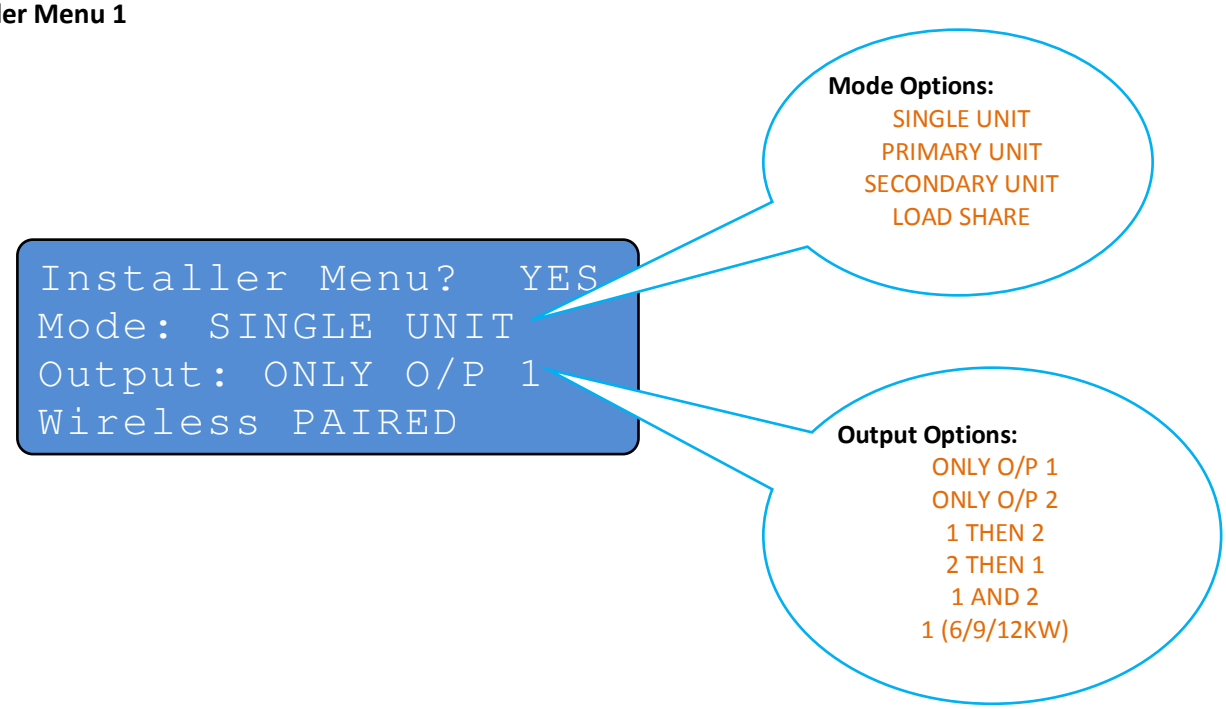
The first installer menu screen sets the basic mode (primary or secondary controller) and the output mode, i.e. which outputs will be used and their priority. Pairing for wireless systems is also activated from this menu.

Installer menus 2 and 3 control the configuration options for output 1 and output 2 respectively, e.g. load power, temperature control method.

Note: If the system will be used for the standard application of diverting excess PV power to a hot water cylinder using a single water heating element the system can be used straight out of the box with no configuration.

The configuration options are described in more detail below.

Installer Menu 1



Apollo GEM Unit Modes

The normal mode setting for a single Apollo GEM installation is “Single Unit”

It is possible however to operate more than one Apollo GEM controller on the same supply and generation system.

If two Apollo GEM controllers were used this would give a total output capability of 7.2KW into two 3KW loads which could be in different locations and would be applicable to micro generation systems sized between 4KW and 10KW.

The Apollo GEM is configured to operate in one of the following modes:

SINGLE UNIT Setting for normal single Apollo GEM controller system. (default)

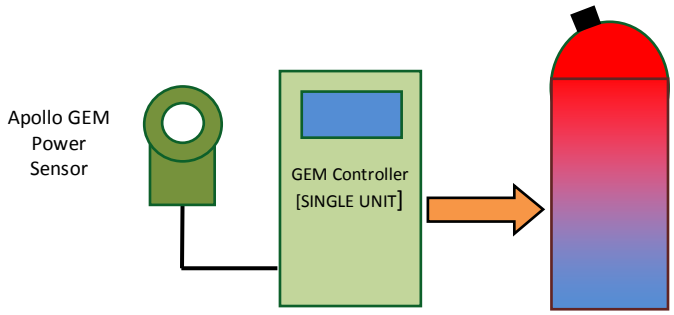
PRIMARY UNIT Sets the controller as the primary unit in a two controller system. When surplus PV power is available the primary unit will take priority over the secondary unit. Surplus PV power will be available to the secondary unit if the primary load reaches maximum power without consuming all of the available surplus PV power or if the set temperature of the heat store is reached.

SECONDARY UNIT Sets the controller as the secondary unit in a two controller system. The secondary unit is able to use surplus PV power when the primary unit is already at maximum power output or no longer requires power due to the primary heat store being up to temperature.

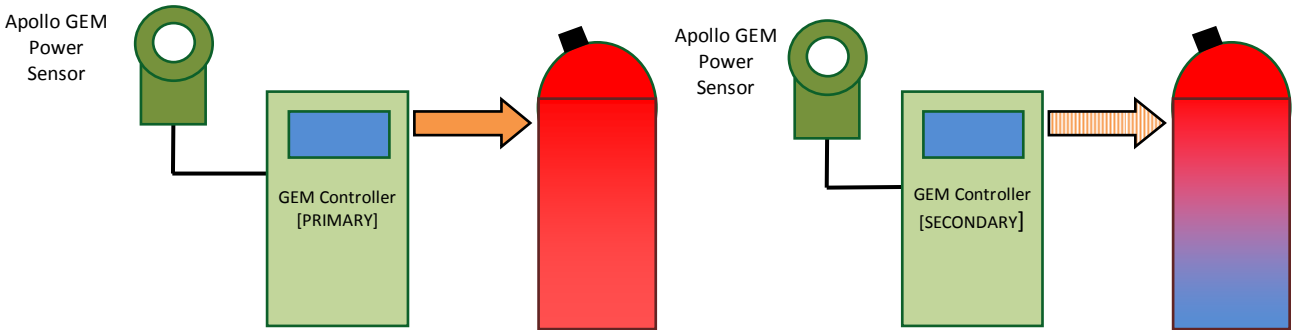
LOAD SHARE In this mode both Apollo GEM controllers in the system will share any available surplus PV power between them. In the event that one of the controllers reaches its maximum output power or the set temperature of the heat store is reached then all further available PV surplus power is diverted to the other unit.

Apollo GEM Unit Modes

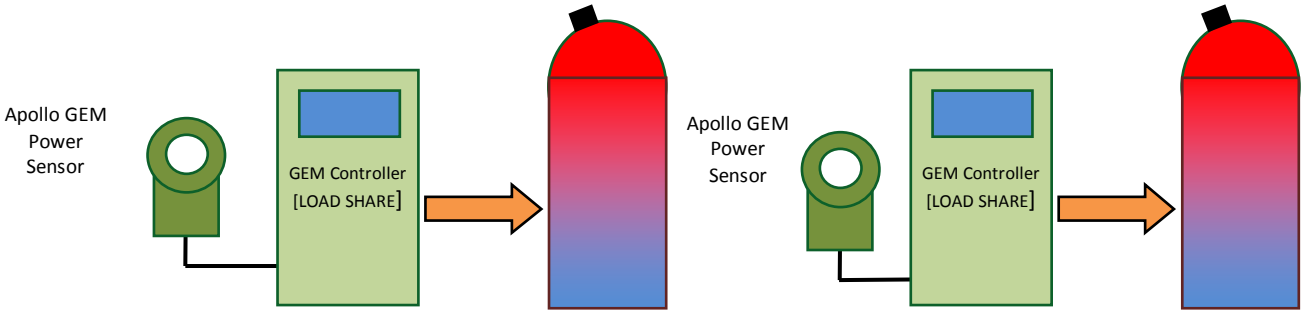
Up to two Apollo GEM units can be used in the same system. For a two unit installation each controller is designated to be a primary or secondary unit using the unit mode parameter in the installer menu. Examples are shown below.



Single Unit Mode – 1 power sensor and 1 Apollo GEM controller



Primary/Secondary Mode – 2 power sensors and 2 Apollo GEM controllers.
Primary takes priority.
Note for wireless systems only one power sensor and transmitter is required.



Load Share Mode – 2 power sensors and 2 Apollo GEM controllers.
Both controllers share PV Power.
Note for wireless systems only one power sensor and transmitter is required.

Apollo GEM Output Modes

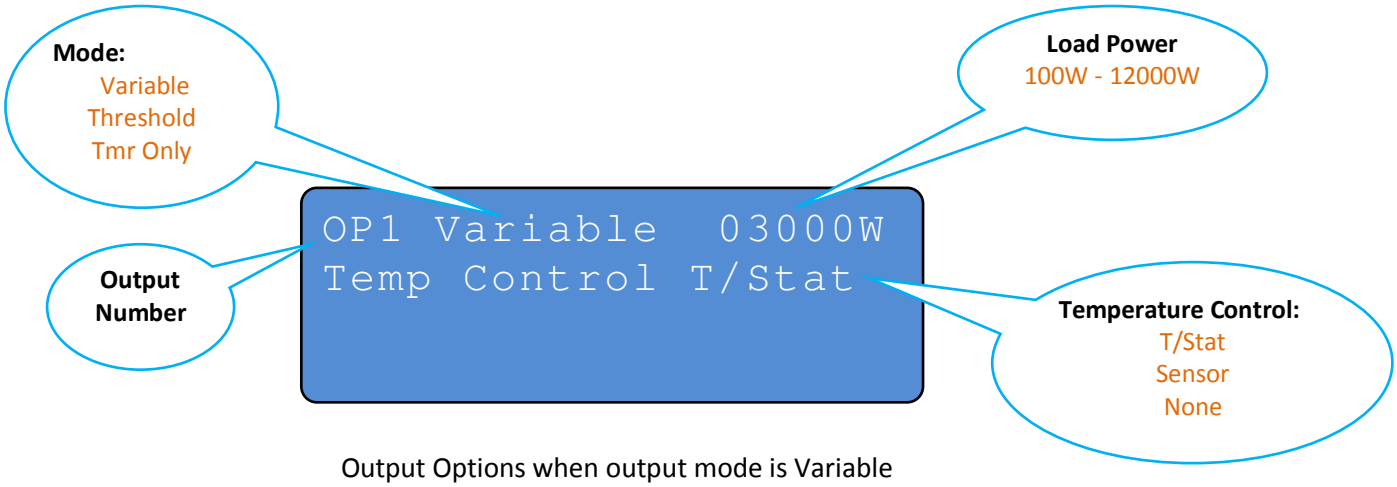
The Apollo GEM controller has two separate outputs. Each output is capable of driving a load up to 3KW. Each output can work in variable power mode (typically for heating loads) or in a threshold driven full power mode, typically used for non heating appliances.

The "Output" parameter described below in installer menu screen 1 sets which outputs will be used and the priority order. Configuration of the outputs themselves is carried out from the respective output configuration menus (installer menu screens 2 and 3).

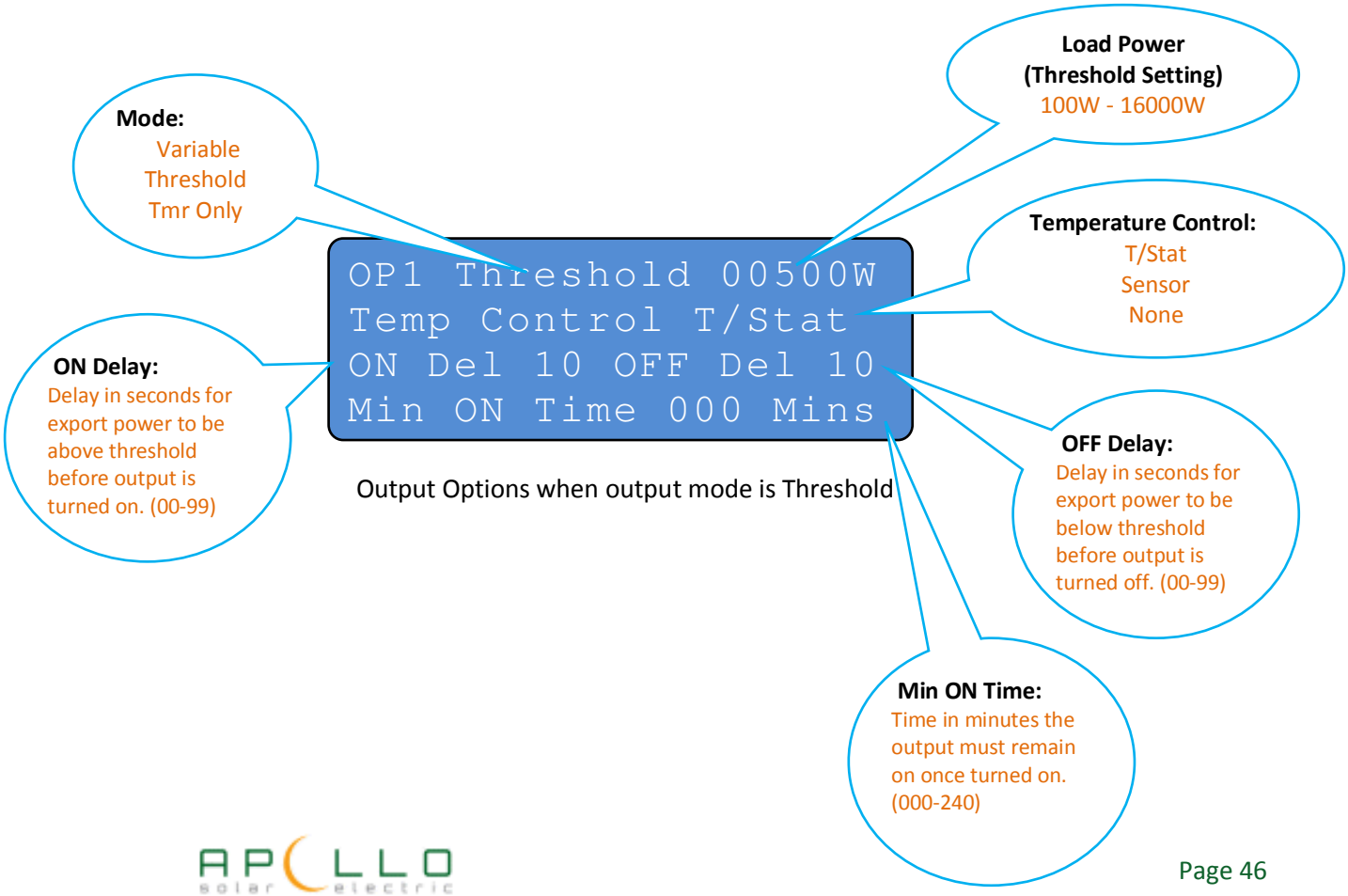
Output mode settings

ONLY O/P 1	Only output 1 is active during PV power optimising.
ONLY O/P 2	Only output 2 is active during PV power optimising.
1 THEN 2 (Priority Mode)	Output 1 is used for PV power optimising until the set temperature is reached and then output 2 is used. If the temperature of the heat store connected to output 1 falls below the set temperature, the system reverts to using output 1 for optimising until the set temperature is reached again.
2 THEN 1 (Priority Mode)	Output 2 is used for PV power optimising until the set temperature is reached and then output 1 is used. If the temperature of the heat store connected to output 2 falls below the set temperature, the system reverts to using output 2 for optimizing until the set temperature is reached again.
1 AND 2 (Power Share Mode)	This mode will share the diverted surplus PV power during PV power optimisation equally between both heat stores connected to outputs 1 and 2. If the set temperature of either heat store is reached then all available surplus PV power is sent to the other heat store.
1 (6/9/12KW)	For larger applications such as swimming pool heating or hot water accumulator tanks the Apollo GEM system can also optionally operate together with up to 2 external contactors to give a total output capability of 6, 9 or 12KW. (16KW for threshold mode)

Installer Menu 2 & 3 (Output Configuration)



Output Options when output mode is Variable


Load Power
(Threshold Setting)
100W - 16000W
Mode:
Variable
Threshold
Tmr Only
Temperature Control:
T/Stat
Sensor
None
OP1 Threshold 00500W
Temp Control T/Stat
ON Del 10 OFF Del 10
Min ON Time 000 Mins
ON Delay:
Delay in seconds for export power to be above threshold before output is turned on. (00-99)
OFF Delay:
Delay in seconds for export power to be below threshold before output is turned off. (00-99)
Min ON Time:
Time in minutes the output must remain on once turned on. (000-240)

Output Options when output mode is Threshold

Output Configuration Options

The output type can be set to work in one of two basic modes, **variable** or **threshold**.

Variable Mode Options

Load Power Should be set to the size of the load connected to the output. This value does not limit the maximum power from the output but tells the controller what size of load to expect. This value should match the maximum load size for optimum performance.

Temp Control

T/Stat The output will use the mechanical thermostat built into the heater to control temperature. Note: for this option to be used the load must be directly connected to the Apollo GEM output and be >100W

Sensor The output will use the optional temperature sensor to control temperature.

None No temperature control is used for this output. Use this setting if the output is connected to a contactor or a non-heating appliance.

Threshold Mode Options

Load Power Set to the maximum load power and is the export power threshold used to turn on the load.

Temp Control As for variable mode above.

ON Del This is the delay time in seconds that the export power must be above the threshold before the output is turned on. Delays of between 0-99 seconds can be programmed.

OFF Del This is the delay time in seconds that the export power must be below the threshold before the output is turned off. Delays of between 0-99 seconds can be programmed.

Min ON Time This is the delay time in minutes that the output will remain on once turned on regardless of whether the export power remains above the threshold. This setting is used for appliances which once turned on must be allowed to finish a cycle etc.

Summary of available output mode combinations

Output Mode	OP1 Setting	OP2 Setting	Operation
ONLY O/P 1	Variable	n/a	Standard variable power load management using only output 1. GEM diverts excess PV power that would have been exported to the heater connected to output 1. This mode is only suitable for connection of "dumb" restive heating loads such as a standard immersion heater.
	Threshold	n/a	Threshold mode load management using only output 1. GEM will wait until the exported excess PV power reaches the level programmed. Once the programmed level is reached output 1 is turned on fully. This mode can be used to connect any kind of appliance.
	Tmr Only	n/a	Timer or Boost operation only. Output 1 will turn on during the programmed ON timer cycles or if manual boost is operated. No automatic load management or optimising is carried out.
ONLY O/P 2	n/a	Variable	Operation is the same as described above for output 1 but only output 2 is used.
	n/a	Threshold	
	n/a	Tmr Only	
1 THEN 2	Variable	Variable	Output 1 operates in variable power load management mode until the set temperature is reached. Output 2 then operates in variable power mode. Priority is given to output 1 and so if output 1 temperature falls below the set point then available PV power is again diverted to o/p 1.
	Variable	Threshold	Mixed mode operation. Output 1 operates in variable power load management mode until the set temperature is reached. Output 2 then operates in Threshold mode and will divert full power to the load once the programmed export threshold is reached. Once threshold control mode has started on output 2, output 1 will remain off even if the temperature falls below the output 1 set point. However, if output 2 has been programmed to use temperature control and the set point for output 2 is reached, then operation will resume on output 1.
	Threshold	Variable	Mixed mode operation. Output 1 operates in threshold mode and will divert full power to the load once the programmed export threshold is reached. If output 1 has been programmed to use temperature control and the set point is reached then operation starts on output 2 in variable power load management mode. Once variable control mode has started on output 2, output 1 will remain off even if the temperature falls below the output 1 set point. However, if output 2 has been programmed to use temperature control and the set point for output 2 is reached, then operation will resume on output 1.
	Threshold	Threshold	Output 1 operates in threshold mode and will divert full power to the load once the programmed export threshold is reached. If output 1 has been programmed to use temperature control and the set point is reached then output 2 then operates in Threshold mode and will divert full power to the load once the programmed export threshold is reached. If output 2 has been programmed to use temperature control and the set point for output 2 is reached, then operation will resume on output 1.

Output Mode	OP1 setting	OP2 Setting	Operation
2 THEN 1	Variable	Variable	Operation is the same as described for 1 THEN 2 but with the priority sequence reversed.
	Variable	Threshold	
	Threshold	Variable	
	Threshold	Threshold	
1 AND 2*	Variable	Variable	In this mode both outputs are active in variable power mode. The available excess power is shared between output 1 and 2, i.e. if 3KW of excess power is available both outputs will receive 1.5KW. If the temperature of either output reaches the set point then all available power will be sent to the other output.
	Threshold	Threshold	In this mode both outputs are active in threshold mode. Once the programmed level for output 1 is reached output 1 is turned on fully. If sufficient excess export power is still available after output 1 has been turned on to reach the programmed threshold of output 2 then output 2 will also turn on fully. Once both outputs are active and the export power level becomes insufficient to support both loads, output 2 is shed first.
1 (6/9/12KW)	Variable	n/a	Operation in this mode allows the unit to operate in variable power mode for combined loads of up to 12KW. In this mode only output 1 is available and up to 2 external contactors are required.

*** Notes when operating in "1 AND 2" mode**

1. Both outputs must be configured to operate in the same mode, variable or threshold.

2. When operating in variable power mode both output loads can be up to 3KW but each output will only receive a maximum of 50% of its maximum rated value.

3. In threshold mode **the total combined load of outputs 1 & 2 must not exceed 3KW** when using directly connected outputs. If using an external contactor for load switching the maximum load on each output can be up to 16KW.

Installing the Apollo GEM Temperature Sensor

The Apollo GEM temperature sensor comprises a 3M cable with a 3mm diameter metal temperature probe at one end and a 4 pin modular jack connector at the other.

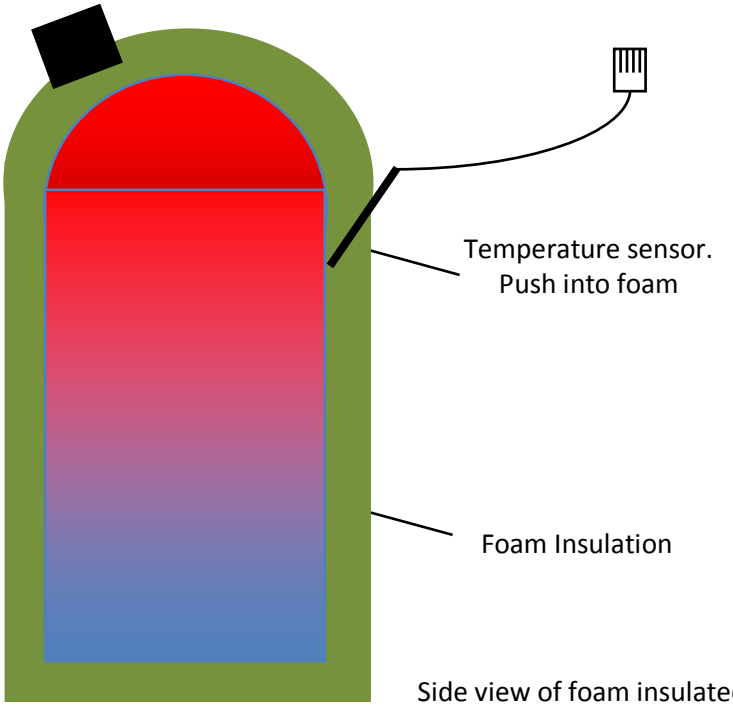
If a temperature sensor is used the sensor cable will need to be routed back from the cylinder to the Apollo GEM controller. 5M and 10M temperature sensor extender cables are available from Apollo Solar Electric.

If the cylinder has a temperature sensor pocket the Apollo GEM probe should be inserted into the pocket as far as it will go.

If the cylinder is a foam insulated type the probe can be inserted directly into the insulation, about half to 2 thirds the way up the cylinder and at an angle of about 30^{o} from vertical.
Push the probe right into the foam insulation until the tip of the probe comes into contact with the metal cylinder (see diagram).

For non-insulated cylinders with a fibreglass jacket, attach the probe directly to the side of the cylinder inside the jacket using an elastic cord or similar. Alternatively the probe can be bonded to the side of the cylinder using an epoxy adhesive.

Plug the other end on the temperature sensor cable into the “TEMP SENS” connector on the right hand side of the Apollo GEM circuit board.



Side view of foam insulated cylinder (section)

Apollo GEM 5 Year Warranty

This Warranty sets out the terms upon which Apollo Solar Electric offers warranty cover for the Apollo GEM products supplied by the company to its customers. Terms defined in the Apollo Solar Electric Terms and Conditions bear the same meaning when used in this warranty. Your attention is drawn to Apollo Solar Electric Terms and Conditions, which includes provisions relevant to the warranty set out below.

Warranty

Apollo Solar Electric warrants to the customer that the goods supplied will be fit for purpose and of a quality as it is reasonable for the customer to expect.
The Warranty Period shall be five years from the warranty date. The warranty date being deemed as the date of the original supply or installation invoice.
In the event of a valid claim resulting from any defect of failure causing the product not to function or perform as design or intended Apollo Solar Electric will either repair or replace, at the company's discretion, the faulty product.

Exceptions

This Warranty will not apply:

- Unless the Apollo GEM Product has been installed by a competent and suitably qualified person according to the installation instructions provided by the company.
- The product has been used and maintained according instructions provided by the company.
- The product has only been used for the purpose intended as set out in the product documentation and specifications provided by the company.
- Unless the customer has informed Apollo Solar Electric of the alleged defect within the Warranty Period and within a reasonable period of discovery.

General Conditions

The customer agrees that he/she will promptly provide all information and support reasonably necessary to enable Apollo Solar Electric to evaluate any alleged defect and to perform its obligations under this Warranty.

The customer agrees that all premises, plant, power, and other inputs that he/she is providing for the installation and use of the Apollo GEM Products are reasonable, are fit for purpose and will be properly used and provided.

Warranty Claim Procedure

In the even the customer wishes to make a claim under his warranty such a claim must be made in writing by post or email to Apollo Solar Electric enclosing the following information:

1. Name and address of the end customer
2. Name and address of the installer
3. Date of installation
4. Detailed description of the problem
5. A copy of the original supply or installation invoice.

If the company considers that the warranty claim is valid under the terms of this warranty the company will then issue a Return Material Authorisation to enable the faulty product to be returned for repair or replacement.

Warranty returns will not be accepted without a valid Return Material Authorisation.